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THE CINCINNATI-NEWPORT HIGHWAY BRIDGE across the Ohio River is to be formally opened on Saturday, Aug. 29. The total length of the bridge is 2,916 ft. The main channel is crossed by a cantilever of 520-ft. span. The shore arms are 252 ft. in length, and beyond them, toward the Kentucky shore, are two trusses of 254 ft. span. The remaining spans are considerably shorter. There are 9 piers containing about 12,000 cu. yds. of masonry, and all were carried to a foundation on rock. The bridge is designed for a live load of 85 lbs. per sq. ft., with additional provision for concentrated loading. The width of the roadway between trusses is 24 ft., with a 7-ft. walk on each side. The clear height of the channel span is 108 ft. above mean low water, and the towers at the ends of this span are 85 ft. above the masonry and 190 ft. above the pier foundations. The owners of the bridge are the Central Railway Bridge Co., of Newport, Ky., of which Mr. JNO. A. WILLIAMSON is President. The King Iron Bridge & Manufacturing Co. took the contract for the whole structure. The plans and specifications for the work were made by Mr. G. BOUSCAREN, Consulting Engineer, and the construction was superintended by Ferris, Kaufman & Co., of Pittsburg, Pa. The engineers for the contractors were Messrs. A. H. PORTER, GEO. E. GIFFORD and F. C. OSBORN.

THE NEW TUNNEL UNDER THE THAMES at Blackwall, London, England, is to be built under the supervision of the London County Council, and proposals for its construction will be received until Oct. 12. It will be a carriageway and footway tunnel, built by the compressed air system, and is to be maintained by the contractor for 12 months after completion. Bidders are required to declare in their proposals that they pay such rates of wages and observe such laws of labor as are generally accepted as fair in their trade. In accordance with the absurd system still in vogue, intending bidders must pay for the privilege of examining copies of the drawings and obtaining the specifications, bills of quantities, forms of proposal, etc., the fee in this case being $50. The tunnel will be 27 ft., and 23 ft. outside and inside diameter, with a roadway 16 ft. wide and 2 sidewalks. The estimated cost is $400 per lin. ft. The project has been reported on by Sir BENJAMIN BAKER and Mr. GREATHEAD.

THE DANUBE IMPROVEMENTS AT THE "IRON GATES" are reported as in rapid progress. The Lobnitz rock chisel is being successfully used in removing ledges. At Greben, an entire promontory has been removed and a dam nearly four miles long has been built. American Ingersoll and French rock-drills are employed in the removal of rock under water.

FRENCH ENGINE-DRIVERS AND FOREMEN are hereafter to be recruited by the railways of France according to rules and requirements of fitness fixed by the Minister of Public Works, M. YVES GUYOT. In an official circular just issued, M. GUYOT calls the attention of managers of railways to the fact that the law of Nov. 15, 1846, distinctly states that "No one can be employed as an engine driver unless he produce certificates of capacity filled out according to forms determined by the Minister of Public Works." This law has not been enforced until now, as it was deemed essential to first make uniform, on all the railway systems, the signals to be used, and to otherwise improve upon the practice on these roads. This uniformity of practice is now an accomplished fact, and the Minister believes that the time has come to enforce the old law, in the interest of the greater safety of travelers. He, therefore, demands that each manager inform him as to the rules in force on their lines in this connection, how these mechanics are recruited or trained, and what are the conditions of fitness required for service. He wishes them at the same time to send in such suggestions as they see fit for a standard set of regulations covering the points in question.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a rear collision, Aug. 19, between two freight trains on a bridge at Montclair Junction, 2 miles from Baltimore, Md., on the Baltimore & Ohio R. R. The first train was standing on the track and the second was an extra train. One man was killed and 2 were seriously injured. Quite a number of other freight train collisions have been reported.

A TRESTLE at Yazoo Pass, Miss., on the Louisville, New Orleans & Texas R. R., gave way under a freight train Aug. 22. Two men were killed. A part of a temporary bridge across the Missisquoi river at Swanton, Vt., was washed out Aug. 22, throwing a team and several persons into the water, but all escaped.

FLOODS have done considerable damage in the neighborhood of Pottsville and Reading, Pa., and caused a washout on the Lebanon Valley R. R. A washout also occurred on the Mississippi River & Bonne Terre R. R., near Bonne Terre, Mo.

LONDON *Engineering* has followed the example of its principal rival, *The Engineer*, of London, and has formed a stock company, to be known as "Engineering" Limited. The capital stock is $900,000, issued in $50 shares. Judging from the names of the first subscribers, this incorporation is little more than a re-arrangement of interests among the previous private owners of that prosperous journal, Messrs. HOLLINGSWORTH, MAW and DREDGE.

AN EIGHT-WHEEL CABLE CAR seating 48 passengers is in use on the One Hundred and Twenty-fifth Street & Amsterdam Avenue Cable Ry. in New York City. Owing to its length and weight the car has two grips, one at at each end, and both operated from either end of the car. The seats run crosswise, with an aisle through the center of the car, and seat two persons each. They are upholstered with woven cane. The car is lighted by gas from a storage tank carried on the truck; one filling of the tank lasting 24 hours. Without over-crowding, as the crowding of street cars goes, the car will hold 80 passengers.

STEEL TIES are being manufactured by the Lackawanna Iron & Steel Co., of Scranton, Pa., for the Morrell Metallic Railway Tie Co., of New Jersey. The ties are to be experimented with on the Dela, ware, Lackawanna & Western and New York Susquehanna & Western.

THE GROSS EARNINGS OF RAILWAYS in the United States for the month of July, according to the *Financial Chronicle*, show a large increase over those of July, 1890, both in amount and ratio of gain. The earnings of 146 roads are $41,674,357, an increase of $3,273,641, or 8.52%. This is the largest gain of any month of the present year. Twenty-two roads exhibit gains of over $40,000 each, and an aggregate gain of $2,896,211, or a very large percentage of the increase shown by the total 146 roads. Six roads show decreases of over $40,000 each, or an aggregate decrease of $309,665.

THE BROOKLYN ELEVATED RAILROAD COMPANY filed its report this week with the Railroad Commissioners for the quarter ending June 30, as follows:

	1891.	1890.
Gross earnings	$460,767	$436,271
Operating expenses	251,298	246,700
Net earnings	209,469	189,571
Other income	2,896	1,657
Gross income	212,365	191,228
Fixed charges	159,897	150,004
Net income	52,468	41,224

The general balance sheet shows resources of $26,346,123, including $26,163,994 cost of road and equipment and $23,937 cash on hand. The liabilities of $26,346,123 include $1,328,360 capital stock, $12,625,000 funded debt and $157,873 profit and loss surplus

A NAVAL TORPEDO AND WAR COLLEGE is to be built at Coaster's Island, R. I., under an appropriation of $100,000 made by the last Congress. The plans are prepared and bids for construction are asked for, The new building, 210×48 ft., will be placed near the present war college.

THE GOVERNMENT RAIN-MAKERS, according to dispatches of Aug. 26 from Midland, Tex., have succeeded in producing nine showers and one "big rain" by the use of oxyhydrogen balloons and dynamite. The most satisfactory result is said to have been obtained with a cloudless sky and every indication of a very dry condition of affairs. Within 5 hours Gen. DYRENFORTH exploded 5 balloons and about ½ ton of dynamite in 10 to 20 lb. lots, scattered over a long line. The bombardment ceased at 10 P. M., and at 3 A. M. a tremendous clap of thunder was followed by a heavy rain, which fell for several hours. At 8 A. M. the rain ceased, but the explosion of more dynamite caused it to fall again. This later experiment was repeated several times. The party now go to El Paso for further tests.

A NEW ASPHALTUM-LIKE INSULATING MINERAL is said, by the *Boston Transcript*, to have been discovered in Texas. According to report it looks like asphaltum, is impervious to water and "unaffected" by heat, acid or alkalies. The further claim is made that it is a "perfect" insulating material, that used as a paint, it will resist the action of heat, salt air, salt or fresh water, gases, etc. This is all very wonderful—if true. The description of the new mineral reads as if it were intended to discover something that was to take the place of the decreasing supply of gutta-percha. In every detail of its many supposed uses it is described as far superior to that valuable gum.

THE COMPARATIVE POPULARITY of radial stay and Belpaire boilers for locomotives has been investigated by the *Railroad Gazette*, and we compile the following table from the reports given by the different locomotive builders:

Name of Works.	Period.	No. or % of crown bar boilers.	No. or % of Belpaire boilers.	No. or % of radial stay boilers.
Baldwin	11 mos., ending June 1, '91	236	75	674
Schenectady*	Two yrs.	....	20	32
Pittsburg	15 mos.†	....	....	....
Cooke	Year.	60.3%	3.8%	35.8%
Rogers	Year.	68¼%	15½%	16%
Brooks	Year ending June 1, '91	94%	None.	6%
New York	Year ending June 1, '91	Principally crown bars.	17%	....
Rhode I'd	Year ending June 1, '91	131	6	72
Portland	Year ending June 1, '91	14	6 (for rotary snow plows.)	None.
H. K. Porter	Year ending July 1, '91	90	None.	9

* Company has built 857 locomotives in past two years.
† Only one Belpaire boiler. Majority of all output has radial stays, and majority of inquiries specify that type.

The Railway Situation in Nicaragua.

At the time of the expedition of Senator MILLER and his party to Nicaragua and the canal, last April, some inquiry was made as to the railway development in that state. The result is given in the accompanying map and description.

At the present time the only railway in operation in Nicaragua is the government line from Corinto, on the Pacific, to Momotombo, on Lake Managua (58 miles); and from the city of Managua to Granada, on Lake Nicaragua (33 miles). These lines are connected by steamer on Lake Managua, the distance from Momotombo to Managua, by the lake, being 30 miles. The railway was built and is operated by the government. The gage is 3 ft. 6 ins., and the rolling stock is of American manufacture. The management of the line is only fair, and in other hands than those of government officials this road could be made more useful than at present. As partly indicated upon the map, which is a copy of one hanging in the office of President ROBERTO SACASA, and is not accurate in its general delineation of the country, the country lying between Managua and Momotombo is much broken up and a difficult one for railway location. It is a volcanic region showing traces of comparatively recent convulsions in the form of great streams of blackened lava. The volcano of Momotombo (not shown, but just north of the town of that name) is even now sending out plentiful jets of sulphurous smoke from its summit.

From the town of Momotombo the government is slowly building a line of railway northward to Sebaco, 80 miles distant. The work is being chiefly done by convict labor, and the ultimate object of the road is to furnish transportation from the mining and coffee regions around Sebaco. The maximum gradient on the line is 3%, for short distances only, and there are no tunnels, only 5 bridges, and the work is generally light. The estimated cost is about 2,200,000 soldes, or about $1,430,000 gold. There is no telling when it will be completed under the present erratic system of construction.

The Atlantic Railway of Nicaragua is a line promoted by English and American capitalists, and it is now under construction. It leaves Lake Nicaragua at San Ubaldo, and terminates at Boca de Rama, 65 miles above Blewfields, and 3½ miles inside the boundary of the Mosquito Reservation. Between these points the distance is 128 miles. The gage of the railway is 3 ft. 6 ins., the maximum gradient is 2½%, and the divide is crossed at an elevation of 610 ft. above the sea by a tunnel 1,800 ft. long. There are two other shorter tunnels on the line. At the time of our visit the whole route was being cleared for a telegraph line, all land rights were said to be secured, and the grading done for a distance of about 4 miles. The concession is good for 7 years with the right of extension, under certain conditions, for 2 years more. The engineers are James Livesey & Sons, of London.

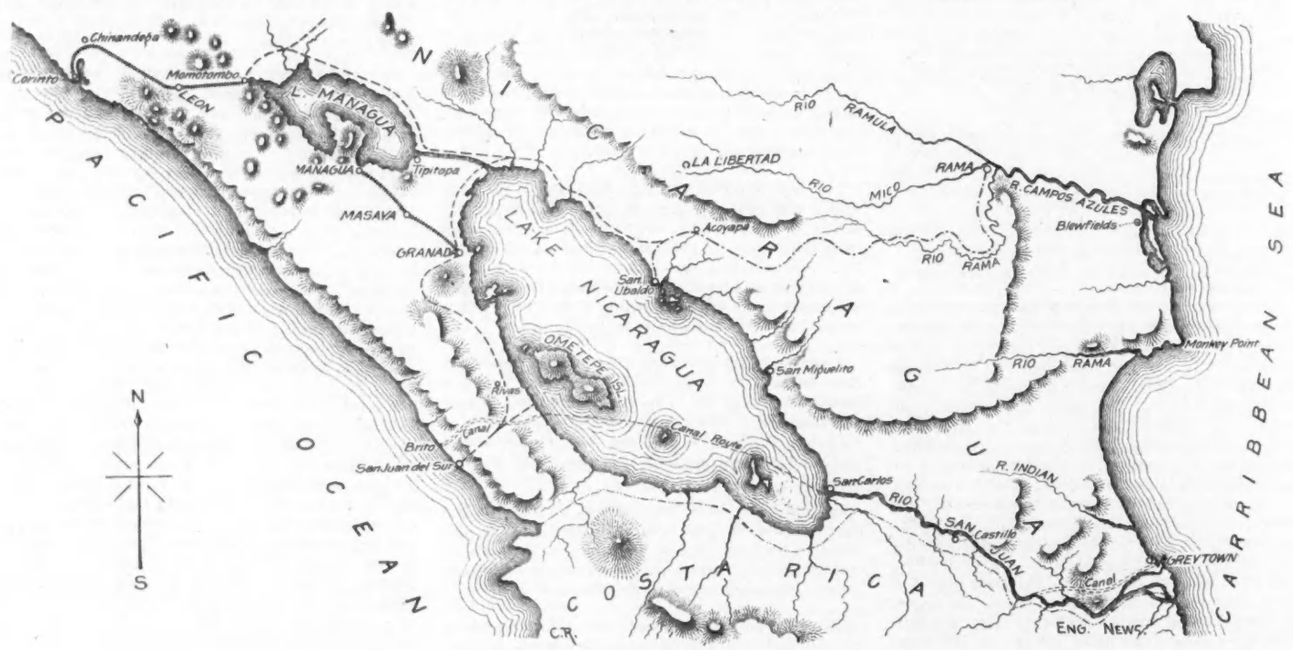
The river Rama, at the terminus of the railway, has from 30 to 40 ft. of water in it at all seasons; but the bar at the mouth, near Blewfields, will only permit vessels of 12 ft. draft to pass in the dry season. From San Ubaldo to El Cuchillo, about 45 miles from Lake Nicaragua, it is comparatively easy work, with an undulating ascending grade. From Cuchillo to the divide and beyond the road is located over a series of rather sharp hills, and the work is correspondingly heavy.

The business expected from the completion of this line is the carriage of the mails and practically all of the imports and exports of Nicaragua, at least until the Nicaragua Canal is finished. But aside from this traffic there is much fine mahogany on the Atlantic slope of the divide, which is now being taken out to some extent by Boston parties for the Pullman Palace Car Co. In addition to mahogany there are fine cedar and nispero forests, with many other varieties of valuable woods practically unknown to commerce. The railway company has a grant of 1,000,000 acres of land in the province of Chontales, lying in alternate strips along the line and at an altitude well adapted for the cultivation of coffee, cocao, and other tropical products. The province of Chontales itself is very thinly populated along the line of the road and the main industry is cattle-raising and the making of cheese; transportation assured would open a ready market for these products in the West Indies.

Chontales is the most advanced mining region of Nicaragua. Gold is the exclusive metal found, and the principal district is about La Libertad. The richest mine is said to be La Garali, belonging to an English syndicate, but very indifferently managed. Five other mines in the neighborhood are in the hands of natives. The ore is usually of a low grade, yielding about ¼ oz. per ton; but it is so soft as not to require the use of a rock crusher. These mines lie at an altitude of about 2,000 ft., and water is plentiful.

Between Rama and Blewfields the banks of the river are studded with banana plantations, and this is the great industry in that section. Not less than 18 steam vessels, of 12 ft. draft, per month load with bananas and other tropical fruit along this river. Of the total product nine-tenths go to New Orleans. The selling price at the time of our visit was 80 cents, Nicaragua, or about 50 cents gold, per bunch of bananas.

This same Atlantic Railway Co. has plotted upon the map shown several very ambitious extensions of the route just described, and we understand that they are included in the general concession. One of these lines connects the San Ubaldo-Rama line with the government railway at Momotombo and Granada; and another connects Granada with Rivas and San Juan del Sur, on the Pacific. As Rivas is a town of about 3,000 or 4,000 inhabitants, and is situated in one of the richest sections of the state, agriculturally, the latter line would seem to be a good one to build. But affairs move slowly in this region, and the Nicaragua Canal and the opening up of this rich country to the outside world are needed to put life into the various enterprises proposed, but awaiting some such event for realization.



THE RAILWAY SITUATION IN NICARAGUA.

Tests of Three Systems of Fireproof Flooring Proposed for Use in the Equitable Building, Denver, Colo.

BY A. MCL. HAWKS.

The office building of the Equitable Life Assurance Society at Denver, the methods of erection of which we described last week, is to be of fireproof construction throughout.

When the matter of fireproofing came up for decision, as several firms offered different systems and materials for use, each claiming superiority, it was concluded to decide the matter by a series of tests, It was arranged that these should determine the behavior of each system of construction under the following conditions: (1) A steadily increasing, quiescent load to the limit of endurance; (2) sudden shocks or blows; (3) sudden changes from a high to a low temperature; and (4) a constant high temperature. The specifications for these tests, as drawn up by the architects of the building, Messrs. Andrews, Jaques & Rantoul, were as follows:

SPECIFICATIONS FOR TESTS OF FIREPROOF-FLOOR ARCHES.

General.—The tests shall consist of four kinds, as follows:

A.—A still-load, increased until the arch breaks down;

B.—Shocks, repeated until the arch is destroyed;

C.—Fire-and-water, alternating until the arch is destroyed;

D.—Continuous fire of high heat, until the arch is destroyed.

The tests shall all be upon arches 10 ins. in depth, with mid-web, built between I-beams 5 ft. on centers; length of arch along the beams not less than 4 ft.

The hollow tiling used by each competitor shall be of

this kind and character; shall be of regular dimensions size, quality, weight, thickness of shell and web, quality of clay, hardness of burn and in all particulars to conform to his regular tiling and be the average material of his kind, and to be an average of his like arches and of his method of construction daily being used in buildings of like character to the Equitable. The tiling and arch used by each competitor shall all be alike. Each test-arch shall be separate and distinct, built upon its own support and foundations, in order that the failure of one arch may not weaken the next. The foundations shall be strong and firm, to insure their remaining intact until the tests are finished, and shall be high enough to raise the bottom surfaces of the arches to the height hereinafter specified. The foundations supporting the I-beams shall be of brick or stone.

The ties, bars, bases, etc., for firmly and rigidly holding beams in place and to prevent any springing or spreading, shall be so strong and substantial as to prevent any movement whatsoever of the beams, in order that the tests may show the full capacity of the tiling. The arches of each competitor shall be built by him in the ordinary way of his method and kind, and there shall be no difference or variation between all of the arches of a competitor. In order that the arches may be ready to test at the earliest day practicable, Portland-cement mortar shall be used in setting the tile—the mixture to be one part of cement to two of sand. The tiling in all the arches shall be left bare without either concrete on top or plastering on the bottom, in order that the tiling alone may be tested and the tests be expeditious. Each competitor shall provide four arches of his kind.

DETAILS FOR EACH KIND OF TEST.

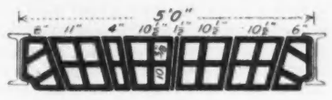
Test A, Still Load.—This arch of each competitor shall remain in accordance with the general specifications, and the bottom of the arch shall be 2 ft. above the ground. Upon the top of the arch loose brick shall be piled, occupying a space of 3 ft. square (9 sq. ft.) in the center of the arch, and shall be piled up steadily and regularly without jars until the arch breaks down. This test shall be applied to the arches prepared for it by all the competitors, at the same time, and they shall be loaded to the same extent in the same space of time.

Test B, Shocks.—This arch of each competitor shall remain in accordance with the general specifications, and the bottom of the arch shall be 2 ft. above the ground. Upon the top surface of the arch there shall be dropped, from a distance above of 12 ft., a piece of timber 5 ft. long and 12 ins. square, and shall be so dropped as to land sidewise upon the arch about the center and parallel with the beams. The dropping of this timber shall be continued until the arch is destroyed. This test shall be applied to the arches prepared for it by all the competitors, consecutively, one after the other, and a record shall be kept of the number of times a blow is repeated before an arch is destroyed.

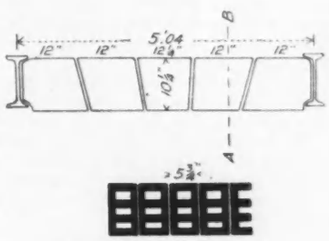
Test C, Fire-and-Water.—The arch of each competitor for this test shall, in addition to the general specifications, be walled in with brick sufficiently to form a sort of furnace with a slight chimney and a draft to insure good combustion. There shall be an ash-pit and a grate provided, the top of the grate to be 2 ft. above the ground and the bottom of the arch to be 2 ft. 3 ins. above the top of the grate. The fuel shall be coal and wood, arranged to form an incandescent bed 8 ins. thick. The top of the arch shall be covered with loose brick to the extent of a weight of 300 lbs. per sq. ft. over the whole top surface. The fire shall be lighted at 8 o'clock in the morning of the day for the tests, and shall be made to burn rapidly and to a high heat, and uniformly over the entire surface throughout the period of an hour and a half, when a stream of cold water from a hose capable of throwing a stream 30 ft. shall be directed up forcibly against the bottom surfaces of the arches, and so continued for three minutes, after which the fires shall at once be renewed and continued for an hour and a half again, when the water shall be applied as before. The fire and water shall thus be applied until the arch is destroyed. These tests of fire and water shall be begun at the same time, and the fires shall be kept to the same heat and in the same condition under all arches prepared for this test, alike.

Test D, Continuous Fire.—This arch of each competitor shall, in addition to the general specifications, be provided with the same kind of grate, the same kind of furnace, the same kind of load on top, the same kind of hot fires, and all things the same as under "Detail Specifications for Test C," except that no water shall be applied The fires shall be continued and made to burn rapidly and vigorously and to a high heat uniformly under the whole surface of the arches prepared for it by the competitors, and shall be started at 8 o'clock in the morning of the day of the test and continued without intermission until the arch is destroyed.

The three firms who entered the competition were the Pioneer Fireproof Construction Co., the Wight Fireproofing Co. and Thos. A. Lee. The style of each competitor's arch is shown in the illustration. All the arches tested were supported by 10-in. steel I-beams weighing 33 lbs. per ft., placed 5 ft. apart, center to center. The beams were tied together in pairs by two ⅝-in. rods, 5 ft. 4 ins. apart, and were strapped at the bottom directly below these by bands of ½ × ¼ in. iron. The beams rested on four brick piers 12 ins. square, securely capped and footed by larger stones. The arches for the first and second tests were built with the bottoms 2 ft. above the ground. Those for the two fire tests had their bottoms 4 ft. 3 ins. above ground. The furnaces were built with 8-in. brick walls, inclosing a grate 3 ft. ×



Pioneer Fireproof Construction Co.'s Arches, A 1, B 4, C 7.



Section on A-B.

Thomas A. Lee's Arches, A 2, B 5, C 8, D 11.

Wight Fireproofing Co.'s Arches, A 3, B 6, C 9, D 12.

TEST ARCHES USED IN THE COMPETITIVE TRIALS OF FIREPROOF FLOORING SYSTEMS.

3 ft. 6 ins. in size, set 2 ft. from the top of the ground. A draft was furnished by a brick flue 6 ins. above the grate. These furnaces were a little too narrow, as they supported the arches and prevented complete destruction, as noted further on.

The Pioneer company's arches weighed, without mortar, 32 lbs. per sq. ft. when new. After the tests some of the tile which were unbroken weighed, as they were in place, 40 lbs. per sq. ft. THOMAS A. LEE's tile weighed, dry and without mortar, 34 lbs. per sq. ft., and after the tests weighed 43¼ lbs., including mortar and water absorbed. The Wight company's arches, without mortar, weighed 40⅜ lbs. per sq. ft., and as it stood in place, including mortar, 43¾ lbs.

TESTS OF ULTIMATE STRENGTH.

The tests for ultimate strength of arches *A*-1, *A*-2 and *A*-3 were begun when the arches were not quite four days old. As no failure that occurred could be traced to weakness of the mortar, it is believed that it was sufficiently set to develop the full strength of the tile. In loading the arch it was decided to use pig iron instead of brick. A crib 3 ft. square and 4 ins. deep was placed on each arch and filled from the arch to the top with dry sand. The weight of this crib and sand was about 430 lbs. in each case.

Pioneer Arch, A-1.—The pig iron was weighed carefully and placed on the sand so as to avoid shocks. With a load of 1,917 lbs. of iron the deflection was 0.01 ft. With 5,429 lbs. the arch broke without warning and without the deflection being measured. The right-hand abutment pieces seemed to give way first, and then the whole arch fell in a mass.

Lee Arch, A-2.—The loads and deflections were as follows:

2,050 lbs.	0.015 ft.
4,337 lbs.	0.016 ft.
5,965 lbs.	0.024 ft.
8,997 lbs.	0.038 ft.
10,284 lbs.	0.040 ft.
13,325 lbs.	0.055 ft.
15,145 lbs.	0.065 ft.

When the load reached about 12,000 lbs., the steel beams deflected considerably in a horizontal plane, and so increased the vertical deflection of the arch. When the load reached 15,145 lbs. the horizontal deflection of the beams at the center reached ⅛-in. The test was concluded at this point, as there was danger of the pile of pig iron toppling over. After two hours the load was removed and the beams and arches came back to their original position. This arch was afterward broken by a blow from the block of wood used in the shock test, failing at the third blow, the stick falling from a height of 10 ft.

Wight Arch, A-3.—The loads and deflections were as follows:

2,538 lbs.	Imperceptible.
3,073 lbs.	0.008 ft.
6,012 lbs.	0.017 ft.
8,024 lbs.	0.018 ft.
8,574 lbs.	?

When the load reached 8,574 lbs. the arch suddenly collapsed by the shearing off of the abutment pieces before the deflection could be observed.

From these three tests it will be observed that the arches made of dense fire-clay, with hollows parallel to the beam, deflect but little in loading and collapse suddenly; while with the Lee porous terra-cotta material, and with the hollows running at right angles to the beam, the reverse is true.

TESTS OF RESISTANCE TO SHOCK.

In the test for resistance to shocks the specifications were changed to blows from a stick 12 ins. sq. and 4 ft. long (weighing 134 lbs.), dropped from a height of 6 ft. for the first blow, and gradually increasing. The tops of the arches were first covered with about 1¼ ins. of loose sand.

Pioneer Arch, B-4.—The first blow, from a height of 6 ft., dropped on the middle of the arch, and at right angles to the beams shattered it completely.

Lee Arch, B-5.—The results of the shock test on this were as follows:

Number of blow.	Height of drop.	Stick parallel or at right angles to beams.	Effect produced.
1	6 ft.	right angles	no effect.
2	6 ft.	parallel	broke bottom web of one tile.
3	6 ft.	right angles	no effect.
4	6 ft.	parallel	broke bottom of two tiles.
5	8 ft.	right angles	broke off part of rear rib.
6	8 ft.	parallel	broke key on rear course
7	8 ft.	right angles	whole rear course fell out.
8	8 ft.	parallel	front key broke.
9	8 ft.	right angles	punched a hole through the middle of the arch.
10	8 ft.	parallel	4 ribs gone.
11	8 ft.	parallel	the arch fell.

Wight Arch, B-6.—The first drop from a height of 6 ft., at right angles to the beams, broke the skewbacks to pieces and the arch fell with only one intermediate tile broken.

In these tests the tile made of dense fire-clay showed themselves to be very brittle, breaking almost like glass; while the tile made of porous terra cotta stood the shocks very well and only broke after considerable pounding, breaking a little at a time and standing after numerous holes were broken through.

HEATING AND COOLING TESTS.

The tests for fire and water and continuous fire were carried on under the supervision of Thomas, Shepard & Searing, mechanical and electrical engineers. The arches were loaded by piling brick on top until the load reached 300 lbs. per sq. ft. The temperature was obtained by a Le Chatelier pyrometer.

Pioneer Arch, C-7.—The temperature was 1,300° Fahr. after the fires had been burning 1½ hours. Water was then applied for two minutes, causing the bottom web to fall from two tiles. Forty-five minutes afterward the temperature was 1,650° Fahr., and water was applied for 4 minutes, breaking the bottom webs on many tiles. In 1½ hours more, at a temperature of 1,350° Fahr., water was applied and the arch fell in ruins.

Lee Arch, C-8.—Eleven times the water was applied, when the temperature had risen above 1,200° Fahr., with the result that two pieces of the bottom web of tiles fell. Otherwise the arch was uninjured. Two days afterward the arch was covered with a layer of sand and the shock test applied. It with-

stood 4 blows at a 6-ft. drop, and 6 blows at an 8-ft. drop, but fell at the eleventh blow, showing as great resistance as the arch subjected to the shock test before the application of fire.

Wight Arch, C-9.—This arch was subjected to fire and water alternately 14 times without falling; but at the end of the test the lower web was gone from every tile and many of the verticals; cracks developed in all directions, and when the setting was removed the arch fell to pieces.

CONTINUOUS FIRE TEST.

Arches D-10, D-11 and D-12.—All these stood the test for 24 hours, and no tile fell from any of them. The Pioneer Arch was similar to all arches built by that company, but was only 9 ins. deep, as the company had not the 10-in. material on hand. They stated, however, that it was as well able to stand the test as a 10-in. arch. When the setting was removed the arch fell to the ground. Lee Arch, D-11, was intact, and carried a load of 12,500 lbs. on a space 3 ft. by 4 ft. in the center of the arch after the fire was put out. Wight Arch, D-12, was nearly intact until the setting was removed, when it fell.

The following data are gleaned from the tests with fire and water:

	Absorbent powers.	Specific gravity.	Specific heat per unit volume.
C-7, Pioneer	5.7%	2.40	05.46
C-8, Lee	32.5%	4.49	0.488
C-9, Wight	5.5%	12.9	0.358

The Metropolitan Railway of Paris.

The Municipal Council of Paris, by a vote of 60 to 9, has adopted a route for rapid transit in that city. The plan adopted is for an underground, or in part a sunken road, commencing at the Arc de l'Etoile. The route proposed is given in full in *Le Genie Civil* of Aug. 1, but without a map its detail would be practically useless. The plan of M. LADAME, which is given below, covers much of the same ground with a seemingly better arrangement of systems. As will be seen from the map published the problem is a very intricate one, and the subterranean plan of execution is practically forced upon the authorities by the irregularities of the streets and boulevards, the inadvisability of blocking these by viaducts or elevated structures and the great cost of real estate. The Paris press congratulates the authorities upon having finally announced their program, and says there is "not a minute to lose now" in putting these plans into operation.

The Ladame Project for Rapid Transit in Paris.

At a time when rapid transit by subterranean lines is interesting the citizens of New York, a study for a similar solution of this vexed question in Paris is issued by Mr. JAMES LADAME, a distinguished French civil engineer, formerly chief of engineers of the railways of the north of Spain and Portugal, etc. By the courtesy of Mr. LADAME we publish a reproduction of his map showing the scheme proposed. This plan is accompanied by others showing farther projects for surrounding the summit of Mont-Martre with a boulevard, and providing access to it by a central elevator shaft and radiating tunnels extending to some distance from the foot of this prominent Parisian hill. Other maps still show other elevated portions of Paris which could be treated in a similar manner, in providing easy access to centers now troublesome to reach.

In connection with the general plan of a new metropolitan system of tunnels shown, it should be remembered that within the month the Municipal Council of Paris has voted in favor of subterranean lines, as being more economical of execution and less objectionable generally, in that city, for the extension of rapid transit and connection of existing lines of railway, than the elevated or viaduct systems heretofore proposed.

Mr. LADAME says that in studying any plan of this kind it must be first considered that the currents of circulation, like the main streets themselves, run parallel or perpendicular to the Seine. This is a state of affairs that cannot be changed, or safely modified, and as a consequence he adapts his system to these natural threads of traffic. There are thus two great systems of tunnels proposed, crossing each other, as indicated on the map presented. Those perpendicular to the Seine are to be located low enough to pass the other system and under that river.

In each system the several lines will be upon the same level, thus reducing to a minimum the motive force required. The projector proposes to use electric motors to avoid the smoke and other inconveniences of steam. And the lines will be connected with the surface by elevators, with emergency stairways. The lines are laid out so as to connect all stations of the railways entering Paris.

Mr. LADAME believes that the construction will not cost more than 2,000 francs per running metre, or say $650,000 per mile, instead of the $1,300,000 to $1,950,000 per mile as estimated for several of the via duct systems already proposed. While, he says, his plan avoids interference with water pipes, sewers, street surface and foundations, we fear that his estimate is too low, even for Paris. But in Paris it is undoubtedly cheaper than the elevated plans which by reason of the street location must perforce pass mainly over private property. The distance below the street level proposed is not given, but the difference in level of the two great systems is indicated as being about 26 ft., or 8 m.

As shown by the full and dotted lines, there is a first system, in each case, and a proposed extension, making a very elaborate network of rapid transit lines. The peculiar topography of Paris makes the plan proposed interesting, and also leads us to congratulate ourselves that the general configuration of Manhattan Island leaves us with a much simpler solution of a similar question.

Irrigation and Irrigation Districts in San Bernardino County, Cal.

BY F. C. FINKLE, C. E.

(Concluded from page 172.)

THE GRAPELAND IRRIGATION DISTRICT.

This district is situated at the foot of the Sierra Madre Mountains, on the west bank of Lytle Creek, and north of the lands of the Semi-Tropic Land & Water Co., the location of which has already been described. The district is composed of 10,787 acres of land, which is held mostly in tracts of 160 acres each by settlers who have obtained it from the Government. There is one tract of 2,000 acres owned by a company. All of this land has hitherto been unproductive for want of water. The district is now fully organized, and it is expected that a water system will be in full operation within a few months. Bonds have been issued in the sum of $200,000, and some preliminary steps have been taken (February, 1891) to acquire a source of supply.

THE RIALTO IRRIGATION DISTRICT.

This district is situated in the center of the San Bernardino Valley, southwest of the town of Rialto and the lands of the Semi-Tropic Land & Water Co. The district consists of 7,200 acres of fine fruit land, which, when irrigated, will make a rich horticultural region. Bonds have been issued for $500,000 to cover the cost of obtaining water and constructing works. The water will come from artesian wells to be bored in the Lytle Creek basin, and will be conducted and distributed in cement pipes. The laying of the pipe has already been begun.

CITRUS BELT IRRIGATION DISTRICT.

Southwest of the Rialto lies the Citrus Belt district, consisting of 11,800 acres of the same class of land as the former. The water for this district will be taken through the main pipe line of the former to the line of the district, the two sharing the expense of the main pipe. The water for the Citrus Belt will be artesian, obtained on land in the same neighborhood as that of the Rialto district. The bonds issued by the Citrus Belt district are in the amount of $800,000, which will easily pay for developing the water, constructing the works and distributing the water to every freeholder in the district.

THE ALLESANDRO IRRIGATION DISTRICT.

This district is situated in the Southeastern portion of San Bernardino Co., and is separated from the San Bernardino Valley by San Jacinto Hills and Box Spring Mountains.

The land in the Allesandro district is owned mostly by the Bear Valley Irrigation Co., who purchased it prior to the formation of the district. The company has subdivided the entire tract into 10-acre lots and laid out and graded streets, giving every lot a frontage. There have been 800 of these acreage lots sold to different parties since the subdividing of the land and the commencing of work on the water system. The water is to be carried from the Bear Valley Reservoir through Bear Creek and the Santa Ana River to the mouth of the Santa Ana Cañon, where it will be taken into a 24-in. steel pipe line, 10 miles long, in which it will be conducted to the district.

The route is over a very rough and hilly country and several tunnels have been necessary in crossing the hills on both sides of San Timeteo Cañon. The longest tunnel is about 2,000 ft. in length, while the others vary from about 200 to 700 ft. in length. After the water has been delivered to the line of the district through this 24-in. pipe it will be distributed to the highest point of each 10-acre lot by a system of vitrified and cemented pipes. Plans for this distribution system, which will comprise nearly 100 miles of all sizes of pipes, have been completed (February, 1891) and a contract has been let for 60 miles of the whole amount. The contractors have begun laying the pipe and the work will be pushed as rapidly as possible. The 24-in. conduit will carry about 20 cu. ft. per second and will be used to supply what is needed immediately. The amount o water required to irrigate the whole district will be about 120 cu. ft. per second, for carrying which a canal will be necessary. After the canal is in operation the pipe line can be used for a domestic supply. The Alessandro District has not issued any bonds as yet, but it is the intention to issue a certain amount to help pay for the construction of the works. The Alessandro District differs from the other districts which I have described, in the fact that the lands are chiefly owned by a corporation which puts in the water system that it may sell its lands at a profit, and its bonds are simply sold to assist in raising the necessary funds. The company in selling the Alessandro lands does not sell the water and an interest in the system with it, but simply sell the right to rent the water perpetually for an annual rental of $2.78 per acre. The water and water system remains the property of the Bear Valley Irrigation Co., and the bonds are received by the company as a subsidy for building the works and agreeing to deliver the water at an annual rental of $2.78 per acre.

DUTY OF WATER AND METHODS OF DISTRIBUTION.

Before closing this contribution I will say a few words about the duty of water in San Bernardino Co. and the different methods employed in irrigating an orchard. Water is measured in San Bernardino Co. by the miners' inch, as in other portions of California.

The statutes of the state define a miners' inch under a 4 in. pressure as being a discharge of .02 cu. ft. per second. The duty of water is always fixed by allowing 1 in. to a certain number of acres of land, so that when land is sold water at the rate of 1 in. to a certain number of acres is also sold with the land and made appurtenant to it. But the number of acres of land which 1 in. of water is made to irrigate varies in different localities from 10 to 5 acres.

In Ontario, for instance, water is limited to 1 in. to 10 acres, while in Riverside it is 1 in. to every 5 acres. Although the soil in one locality may be such that it really requires less water than in others, yet this is not the reason why there is such a difference in the amount of water used in different localities. It is simply fixed arbitrarily by those who start a colony and begin selling the land and water.

The writer believes, from his experience and what results have come under his observation, that 1 in. to 5 acres is nearer right than 1 in. to 10 acres. It has been shown that as trees grow and become larger they require more frequent and copious irrigations, and that 1 in. of water to 5 acres for an old orchard is none too much, although while the orchard is young one-half of that amount may suffice.

It has also been shown that while an orchard which is given 1 in. to 10 acres may have trees that are just as large and thrifty as an orchard on which 1 in. to 5 acres is used, yet the latter will invariably yield more fruit than the former. It is therefore poor economy to use too little water, even if the trees are made to grow and look well by so doing. Now, the reader may have inferred from what has

been said that a man who has 5 acres of ground to irrigate allows 1 in. or .02 cu. ft. of water to continually flow on the land to keep it moist.

But they do nothing of the kind. All water companies distribute the water by giving each owner a certain time to irrigate, in which time enough water is given to make what is termed an irrigating head, enabling him to flood his place in a short time. Suppose that there are 10 neighboors each having 10 acres of land and 2 ins. of water. That makes a whole of 100 acres of land and 20 ins. of water. Now, these 10 neighbors organize and proceed in the same way as if the 100 acres and 20 ins. belonged to one person. They come to the conclusion that it is not necessary to irrigate a piece of land oftener than once every 10 days and one man takes the whole 20 ins., which gives him a good irrigating head, and floods his 10 acres in one day; the next day some one else takes the water and does the same, and so on until at the end of 10 days the whole hundred acres have been irrigated and the turn of the man who had irrigated first comes to irrigate again. This is precisely the way water companies apportion the water to land owners, and a man called a *sanjero* (a Spanish word meaning ditch-man is employed to deliver the water at the right point in the correct amount, and at the proper time, to each land owner. The reason why this method of allowing the flow to accumulate and using a greater amount at stated intervals is practiced is that a person could not accomplish anything with a stream of water amounting to only one or a few inches, and that it would be a great inconvenience to be compelled to be at work irrigating all the time.

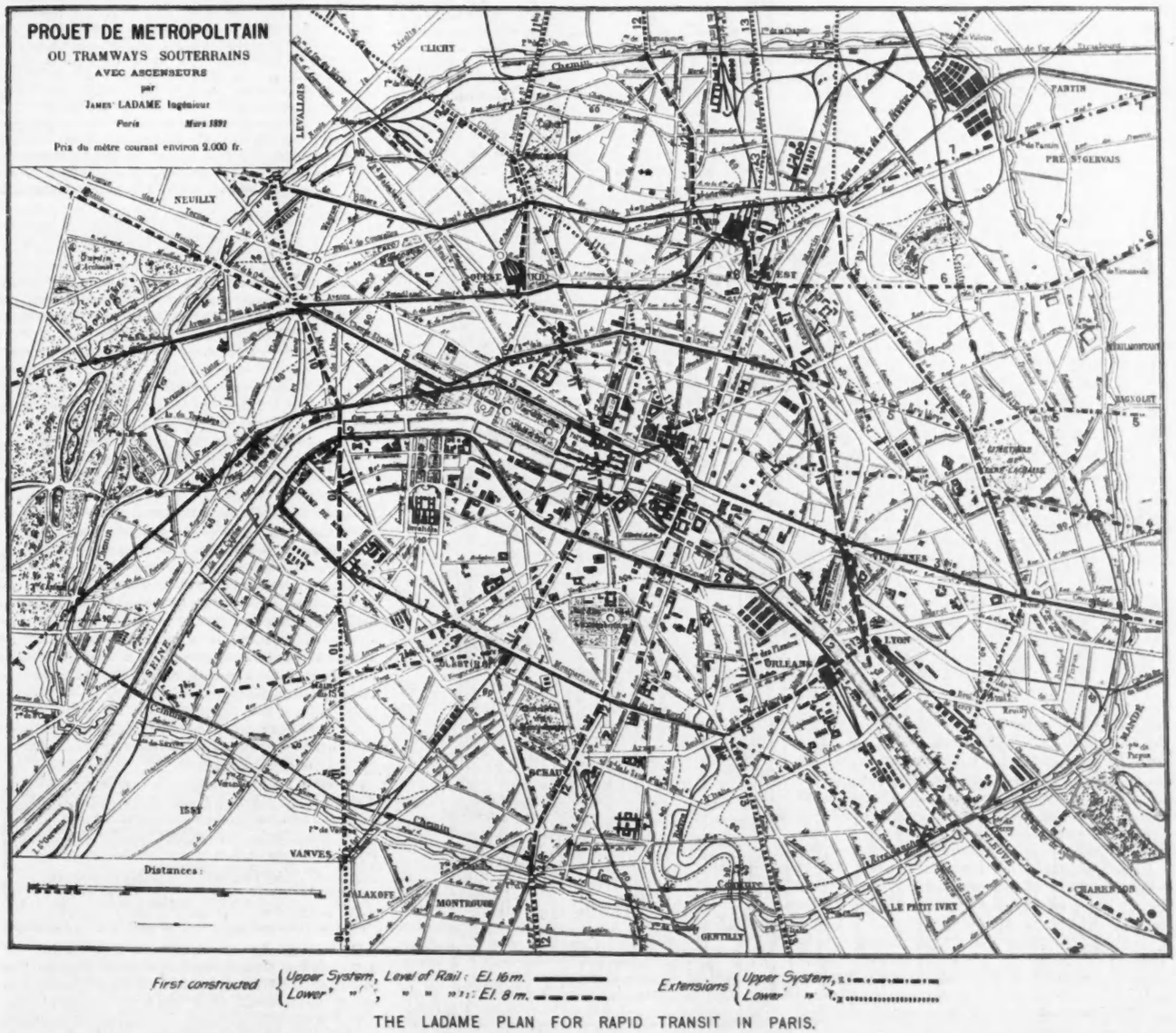
In irrigating the water is taken into a ditch, flume or pipe, constructed along the side of the land which is the highest in elevation. A ditch is the crude and primitive method and is generally replaced at the present time by a flume or pipe. If a flume is used there are holes in the side facing the land with plugs for each hole, so that the water can be let out at any point by simply removing a plug, and on a pipe, if that be used, there are hydrants placed at stated intervals so that the water can be delivered where desired by opening the proper hydrant. There are three methods commonly used in irrigating an orchard. One is the basin method, which is by digging a basin around the tree and filling it with water, and when the water has soaked away, filling the basin with earth to keep the moisture. Another is the row method, which consists in plowing a wide furrow on each side of a row of trees and making numerous small dams across it. The water is then let in at the head of the row and allowed to fill each compartment formed by the dams in the furrow when it will gradually break over and fill the next until the whole row has been irrigated. The third method consists in plowing small furrows at right angles to the flume close together throughout the whole orchard. The water is then let in the furrows and allowed to flow along slowly, thoroughly soaking the whole surface of the ground.

The objection to the first two methods of irrigating is that they only wet the ground near the tree and the roots will therefore not grow outward and penetrate the space between the rows, thus enabling the tree to draw nourishment from all parts of the soil. The last method overcomes this objection, and although it takes more water to irrigate in this way it is fast taking the place of the others, and I think will in the course of time be the only method recognized.

Proposed Road-Making Machine Contest in Missouri.

The State Board of Agriculture of Missouri has arranged for a friendly contest of road machines or graders of various types, to take place in Mexico, Mo., on Sept. 15, 16 and 17 next. Prof. HIRAM PHILLIPS, Professor of Civil Engineering in the University of the State of Missouri, will assist the Board in this trial in all that applies to the mechanical construction of the graders, capacity for work, draft, etc., and a committee of experts in practical road-making will pass upon the merits of the several machines and their efficiency in work performed.

The Board has issued a circular calling attention to the points to be considered in the coming trial. These points are interesting as showing what is required of a modern road-grader, and are as follows:



THE LADAME PLAN FOR RAPID TRANSIT IN PARIS.

General construction: Quality and class of material; mechanical proportion of parts; durability; draft; ease of management and adjustment for various kinds of work; ability of machine to do its own plowing; borrowing from banks outside of wheels; making ditches; filling ditches; moving earth either right or left, ordinary work; moving earth either right or left up steep slope; moving earth straight forward and down hill; working side hill, borrowing from one side filling other; behavior of machine when working gravel or stony hills, hard clays, gumbo or hard packed roads; acute working angles of blade; position of blade to ground and ability to scour or shed earth; freedom from choking in high grass, weeds, heavy, sod or wet ground; freedom from sliding or slipping sideways; average distance earth is moved at each successive round from bottom of ditch to center of grade; capacity of machine to build a given amount of road in given length of time; quickness of action and power applied to blade by levers used.

Tests of Coil Boilers for the U. S. Navy.

On Aug. 2, 1888, the Navy Department issued an advertisement inviting manufacturers of sectional, coil or tubulous boilers to furnish plans of the same for use in an armored coast defense vessel, accompanied by certificates that boilers of the same make had been in successful use at sea or on shore. A number of boilers were offered, and to determine their relative superiority the Department arranged for a series of tests to be conducted by an engineer board headed by Chief Engineer CHAS. H. LORING. The makers who signified their intention of offering their boilers for competition in this test were F. B. King, Washington, D. C.; the Hohenstein Mfg. Co. Newark, N. J.; Wm. Cowles, New York, and Chas. Ward, Charleston, W. Va. Subsequently, the two first named withdrew, and the tests were therefore carried out on the boilers of Messrs. Ward and Cowles.

The Ward boiler was tested at Charleston, W. Va. Dec. 10, 1889, by a board consisting of Messrs. CHAS H. LORING, GEO. W. MAGEE, J. J. BARRY and CHAS. P. HOWELL. After some preliminary working the boiler was tested by two 12-hour runs, in which capacity, efficiency, etc., were determined in the most accurate manner.

The Ward boiler, as set up for test, is shown in vertical and horizontal section by Figs. 1 and 2, and is described as follows by the board:

The boiler has a plate-iron central drum standing vertically in the center of the system and extending from beneath the grate to about 11 ft. 6 ins. above the base line. It receives all the feed water from an inside pipe that passes through its bottom and extends to near the water-line. The space above the water-line forms practically all the steam room. Surrounding this drum in nearly concentric circles are eight separate coils or sections, varying equally in dimensions from 36 ins., that of the inner one, to 110 ins., that of the outer one. Each section has 30 tubes or complete circles, in all 240. The tubes of each section are connected in half circles by screwed joints to two vertical headers diametrically opposite to each other. The tubes are 2 ins. in external diameter, and are set at an angle of about 10° with the horizontal, to give direction to the current of circulation within them. The headers carrying the lowest ends of the half circles have a common connection at their bottom ends with a manifold, which at its inner end is connected with the central drum. Through this manifold they are supplied with water. Their upper ends are closed.

The headers carrying the highest ends of the half circles connect with a manifold at their tops, through which all steam generated passes into the upper end of the central drum. At their bottom ends they connect with a manifold which serves as a mud drum, and as a blow-off for purging the boiler. The headers proper do not extend below the level of their circular tubes, the connections with the lower manifolds being through iron pipes, 3½ ins. in diameter, screwed into the bottom ends of the headers and joined to the manifolds by shallow stuffing boxes. These manifolds are beneath the grate, and they and the headers are of cast steel. The grate is an annulus and has an area of 66.5 sq. ft. This was reduced to 53 sq. ft. for the test, by bricking, for convenience of manipulating the fires.

The total heating surface measured on the exterior of the tubes, headers and drum is 2,490 sq. ft.; measured on the interior it is 2,074.5 sq. ft. A portion of this heating surface was, however, covered by the bricks laid on the grate, so that the area of the superfices was reduced to 2,473.5 and 2,060 sq. ft., respectively. About 30% of this heating surface is above the level of the mean water line. Undoubtedly there is always, when the boiler is under forced draft, a very large amount of water circulating through these upper tubes and receiving steam-producing heat from them; but it is impossible to establish their exact value as water heating surfaces. As it is probable that all the boilers tested by this board will be similar in this particular, comparisons may be justly made by the use of the total heating surface for the purpose of the above mentioned table, at least when no superheating is apparent.

The greatest diameter of the outer casing is 10 ft. 3 ins.; the diameter of the outer casing around the drum above tubes, 4 ft. 6 ins., and diameter of smoke pipe, 3 ft. 4 ins. The height from base to top of drum casing is 11 ft. 8 ins. and from base to top of casing around tubes 8 ft. 2 ins. The light iron casing that envelopes the furnace and tubes is lined at the furnace level with fire-bricks, above that, with curved tiles hollowed in the back.

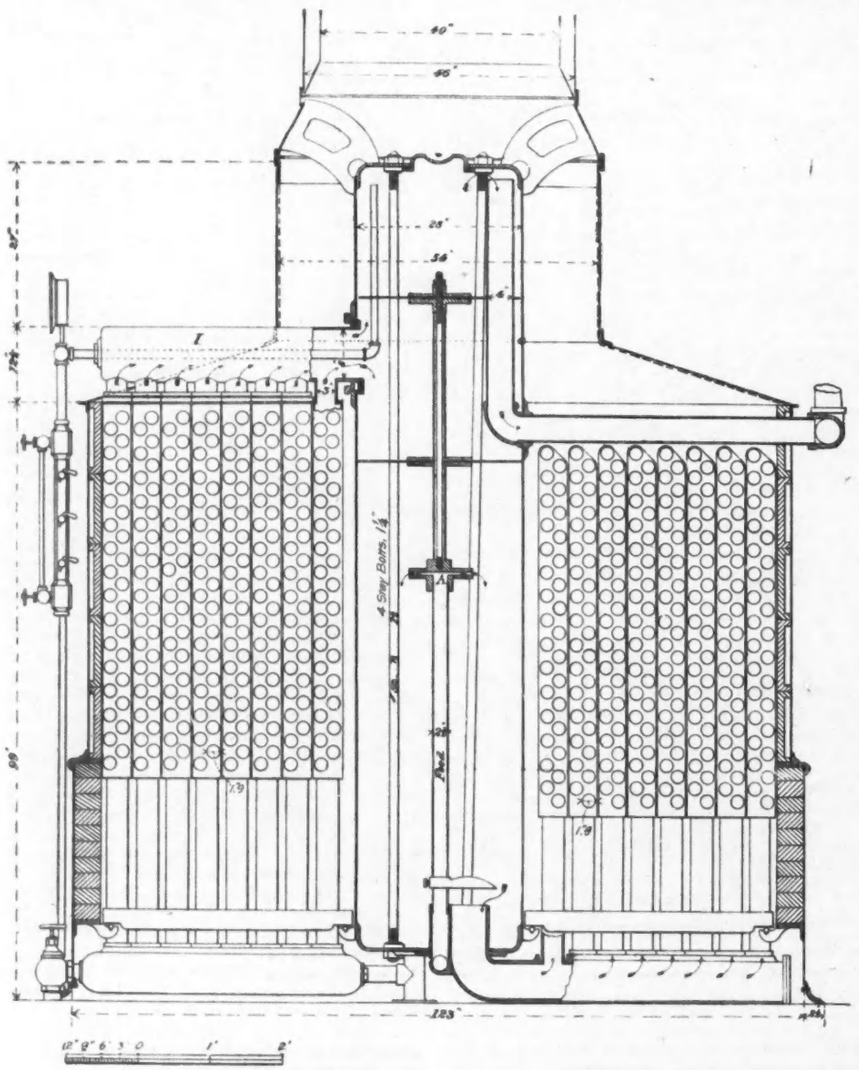


FIG. 1. WARD'S GOIL BOILER FOR NAVAL USE, VERTICAL SECTION.

The complete boiler weighed empty 26,533 lbs.; and when filled with water to the second gage, 31,026 lbs. The test of the boiler was made under forced draft on the closed fire room system. The air-pressure used was that indicated by 2 ins. of water. The coal used was a West Virginia coking coal containing 70.67% carbon, 25.35% volatile matter, and 4.02% sulphur, moisture and ash. It burned with little manipulation and the fires were not cleaned at all in the 12 hours' run. The steam generated was used to drive the blowing engine, feed pump and a large steam pump 200 ft. away. The surplus, constituting the principal portion of the evaporation, was blown off through a screw stop valve which was in charge of an attendant who so moved it as to keep the boiler pressure constant at 160 lbs. Tests of the quality of the steam were made at hourly intervals with a barrel calorimeter. The results of the two days' tests are summarized in the following table:

CAPACITY.

	Fuel.	Combustible.
Lbs. burned per hour	2,018	2,776
Lbs. burned per hour per sq. ft. grate	55	52
Lbs. burned per hour per sq. ft. heating surface	1.179	1.122
Water fed per hour at 50.4° Fahr. lbs.		19,425
Steam made per hour at 169 lbs. pressure lbs.		16,843
HP. per hour at 20 lbs. steam = 1 HP		842.1
Steam per hour per sq. ft. grate surface lbs.		318
Steam per hour per sq. ft. heating surface lbs.		6.81
Sq. ft. of heating surface per HP. (20 lbs. steam)		294
HP. per sq. ft. of grate surface		15.9
HP. per ton (2,000 lbs.) weight of boiler in working condition		56.2
Weight of boiler per sq. ft. heating surface lbs.		12.5
Time required to evaporate a quantity of water equal to total contained (at two gages)		14 minutes

Examining the above table, it appears that the boiler showed remarkably large power in proportion to weight. The heating surface showed a fair efficiency, and the weight of the boiler is only 12.5 lbs. per sq. ft. of heating surface, whereas the ordinary marine boiler weighs 50 to 75 lbs. per sq. ft. of heating surface, and even the locomotive boiler weighs 17 to 25 lbs. per sq. ft. of heating surface. The steam made, as seen above, was quite moist, averaging 13⅛% of entrained water. If this had been trapped in a separator and led to the hot well so that no loss of heat had resulted, the capacity of the boiler would have been increased and the economy would have been helped very materially. Since the test was made, the diameter of the steam manifold (I, Fig. 1) has been increased to 10 ins., which the Board thinks may lessen the moisture in the steam. The follow

ing are the results of the test in the matter of economy:

ECONOMY.

Evaporation, lbs. of water.	Per lb. of fuel.	Per lb. of combustible.
Apparent evaporation, by tank measurement, from feed at 50.4° Fahr. to steam at 160 lbs.	6.60	6.93
Equivalent apparent evaporation from and at 212° and under atmospheric pressure	8.03	8.44
Actual evaporation into steam at 160 lbs. from feed at 50.4°	5.77	6.07
Equivalent actual evaporation from and at 212° and under atmospheric pre sure	7.03	7.39
Potential evaporation, or evaporation had all the heat lost through water entrained in the steam been utilized in converting the water in boiler into dry saturated steam from feed at 50.4° to steam at 160 lbs. pressure	6.00	....
Equivalent potential evaporation from and at 212° and under atmospheric pressure	7.31	7.68

Considering the heavy forced draft under which the boiler worked, this seems a very fair result. The principal loss of heat was due to the hot gases passing into the uptake, the temperature in which, according to the pyrometer, was from 788° to 972°, averaging 882° in the 24 hours.

From the small amount of water contained in the Ward boiler, close attention to the feed is necessary. It will be noticed, however, that the parts exposed to the direct action of the fire are at the bottom of the boiler, and so the water may get quite low without causing material injury to the boiler.

To demonstrate the ease with which repairs could be made, the upper part of the boiler was stripped and the inner coil was hoisted to a position corresponding with the level of the deck beams on board ship. This was done by a half dozen men in about four hours. In this position any of the tubes could be examined and replaced if necessary. If desired a section may be lowered into the furnace instead of being hoisted for repairs. No space around the boiler is required for repairs except to the outer casing.

Tests of the Cowles boiler were made by the Board at the Brooklyn Navy Yard on April 28 and May 8, 1890. At the close of this test the Board reported their conclusions, which were substantially that the relative evaporative efficiency was 1.086 for the Ward to 1 for the Cowles; the relative weights were 1.186 for the Ward to 1.50 for the Cowles; and, "in the matter of accessibility, ease of making repairs, and simplicity and interchangeability of parts the Ward boiler has a considerable advantage over its competitor. In ease of firing they are equal. For the care of the feed the Cowles has a great advantage over the Ward, though fortunately the liability to damage from fluctuations in the water level in the latter is small."

In accordance with the report, the Ward boiler was adopted for the coast defense vessel *Monterey*; and four of these boilers, with a collective HP. of 4,500, have been placed on board that vessel. The contract price was $60,000. The boilers are like those illustrated, except that one section is added, thus considerably increasing the capacity of the boiler and making the outside diameter 11 ft. The height is about 12 ft. These boilers furnish about three-fourths of the boiler power of the vessel, the remainder being furnished by two boilers of the ordinary Scotch type.

If these boilers prove satisfactory, it is quite probable that coil boilers may be largely used in further naval construction. Chief Engineer MELVILLE says in his report:

> The decrease in weight for a given power is but one of the advantages to be gained from the use of coil or tubulous boilers, though this alone would warrant their being used. Another and very important advantage in favor of employing them in war ships is that from the small quantity of water they contain and the perfect circulation, steam can be raised in a coil boiler, without injury, in a very much less time than in one of the locomotive or Scotch type, even though the latter be fitted with mechanical devices for forcing the circulation. With a coil boiler all the time necessary is that required to start and build up the fire, say half an hour, with soft or semi-bituminous coal. This point was kept steadily in view when it was decided to adopt boilers of the coil type for three-fourths of the power of *Monterey*, for the service she is to perform (coast defense) will require her to be ordinarily at anchor or under easy steam; if she is under way, with the two Scotch boilers with which she is provided in use, she can attain a speed of about 10 knots; this can be increased to 16 in a half hour by firing up her coil boilers. Or if she is at anchor with no steam at all, or only sufficient to run the dynamo engine and other auxiliaries in constant use on a modern ship, she can in an emergency be under way and running at a speed of 14 to 15 knots half an hour after fires have been started in the coil boilers. To keep a ship with ordinary boilers in such readiness as this would be simply impossible unless she happened to be near a coal supply; for the fires would require to be kept so heavily banked that the supply in her bunkers would soon be exhausted.
>
> Coil boilers are cheaper for the same power than either the Scotch or locomotive type. They can be taken to pieces and shipped in comparatively small packages to a vessel in any part of the world; arrived at their destination, the old coil boilers (if the ship is so fitted) can be taken to pieces and hoisted up the fire-room hatch, and the new ones lowered and connected together, all by the force on board. They can be forced with greater safety than can a shell boiler, since in a properly designed coil boiler the circulation of water will increase with the intensity of the fire, and if steam is washed off a heating surface as soon as it is formed, no overheating nor burning can occur. A serious explosion with this type of boiler is impossible.
>
> The use of boilers of the coil type in vessels of small displacement and enormously large power, like torpedo-boats and cruisers, is already a necessity, and, in my opinion, it will not be many years before their use will be general in all steam vessels, merchantmen as well as men-of-war. The most serious objection to them is that they require clean fresh water for feed, but by the use of evaporators and filters this can be accomplished.
>
> Besides these points it is to be remembered that the use of forced draft, which has practically revolutionized marine steam engineering, both in the merchant and naval service, meets its chief obstacle in the rapid deterioration of the boilers. With a boiler which can endure a forced draft of 2 ins. of water in regular service without injury, forced draft would become the rule. The great saving in weight and space which is effected by coil boilers using forced draft may have most important results in the development especially of torpedo boats, fast cruisers, and Atlantic greyhounds.

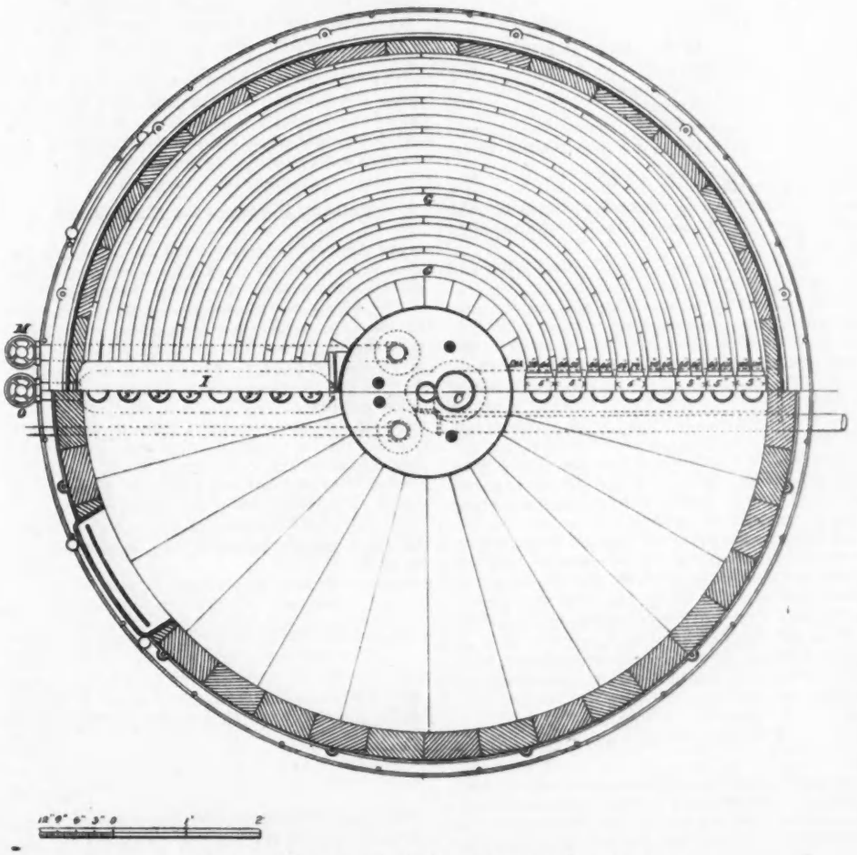


FIG. 2. WARD'S COIL BOILER, HORIZONTAL SECTION.

The Waterway Between Jetties.

To the best of our knowledge the usual method of proportioning the width between jetties, or the waterway, in the improvement of tidal rivers by restriction of channel width, has been one controlled simply by past experience and a careful comparison of observed results. No one would deny that the width of this entrance channel must have an important effect upon the local tidal action in creating or maintaining a desired depth of channel, and that this width, if not properly proportioned, will seriously affect the upper reaches of the river by diminishing the tidal range. In the river itself the loss of volume is usually counterbalanced by the restriction of the current to narrower limits. But the decrease of discharge at the entrance may proportionally interfere with the maintenance of a channel over the outer bar. There is a close relation between the improvement of the upper river and the bar at its mouth; and as these conditions may conflict, it is the duty of the engineer to endeavor to reconcile these conflicting interests.

The first attempt that we have seen in the direction of establishing a rule for adjusting these interests is the work of Mr. E. A. GIESELER, Assistant U. S. Engineer at Savannah, Ga., and published in full in the *Franklin Institute Journal* for August. Mr. GIESELER set out to develop a mathematical expression for the conditions of the river bed required for a propagation of the tidal wave with undiminished range, and thus incidentally to fix the distance between the jetties at the mouth of the river, when these are used. He first gathered and carefully studied all data available from many large rivers in the United States and abroad. The high-water cross-sectional area of each river was determined at as many points as possible, and for each such point the superficial area of the tidal basin above was computed. The former was then divided by the latter, and to avoid cumbrous decimal fractions, the quotient was multiplied by 1,000,000. Other things

being equal, these quotients must be reduced to a common basis by dividing each by the tidal range belonging to it.

In this way a coefficient C is obtained from the expression $C = \frac{A}{R\,S}$, in which A is the high water cross-sectional area mentioned, in square feet; R is the mean tidal range in feet at the same point, and S is the superficial area of the tidal basin above such point in millions of square feet. From the coefficients thus obtained, and means of these coefficients taken for stretches of a river on which the rate of increase or decrease remained the same, Mr. GIESELER finds two expressions. The first of these is

$$A = S\,R\left(11.5 + \sqrt{\frac{562{,}500}{S\,R}} + 132.25\right)$$

This expression, with the same values in feet and square feet as before given, gives the cross-sectional area required for a propagation of the tidal wave with undeminished range, in terms of the tidal range and the area of the tidal basin. From another equation not here given, the author then obtains $S = \frac{A^2}{R\,(23\,A + 562{,}500)}$; which gives the superficial area of the tidal basin above a point lying on a stretch of river on which the tidal range undergoes no change.

For the more elaborate mathematical work and the various equations, plotting of data and the successive steps taken, we must refer readers sufficiently interested to the original paper. But we think that enough has been given to show the results of some very careful work, that has stood the test of observed tidal phenomena. Of the useful application of these formulæ to practice, as opposed to former cut-and-try methods, there can be no question, and Mr. GEISELER deserves due credit for his formulæ here given. We understand that his efforts have been highly commended in military circles, and that his report will be embodied in the official publications of the Chief of Engineers.

As showing the practical application of the first formula given above, the author assumes that the construction of training walls was contemplated for the mouth of the Clyde, 5¼ miles below Dumbarton Castle, and to allow a present tidal range of 10 ft. to pass undiminished up the river. Then A, or the opening between these walls, taken with other data belonging to that river, must not be smaller than—

$$A = 350 \times 10\left(11.5 + \sqrt{\frac{562{,}500}{350 \times 10}} + 132.25\right) = 100{,}700 \text{ sq. ft.}$$

In connection with the equations given, the author reminds the reader that while the units A and R are in square feet and feet respectively, the unit of S is 1,000,000 sq. ft. In the case of rivers where the mean range does not remain constant, the equation for A can be still applied by finding another height of range which passes up the same stretch unchanged; unless the changes are very great. In the case of decrease of mean range, this constant range will be smaller, and in case of increase it will be greater.

A New Phase of the South Pass Problem.

The South Pass outlet of the Mississippi River in its original condition, previous to improvement by the late Capt. EADS, had a depth of only about 15 ft. across the bar at the head of the Pass. The amount of water flowing across this shoal was not sufficient to make and maintain the channel required, and to increase this volume of discharge was almost as serious a problem as that of opening the channel across the bar into the Gulf.

The increased flow needed was obtained by narrowing the two main passes with dykes, and protecting their channel beds from scour by submerged mattress sills extending the entire width of these passes. The flow into South Pass from the increased head thus obtained has been sufficient to maintain a channel of required dimensions up to the present time. During the recent heavy rise in the river, however, a crevasse was cut through the right bank of the Pass-à-Loutre, into Garden Bay, about 1¾ miles from the head of the passes, which, unless soon closed, may produce a general shoaling in the South Pass channel. The crevasse is now 900 ft. wide, 28 ft. deep, and has a discharge of at least 1½ times that of South Pass. The channel in the head of Pass-à-Loutre has deepened considerably, and the increased flow caused by the discharge through the crevasse into Garden Bay must necessarily decrease the volume of water flowing into South Pass. The difference of level of Garden Bay and water in the river at the crevasse is about 2½ ft. at times of high water.

This crevasse should undoubtedly be closed by the government, as it is outside the limits of the South Pass improvements, and on a channel under government control.

To delay action in the matter until government aid could be obtained might be disastrous to the present jetty channel; and Mr. GEORGE Y. WISNER, the engineer for the JAMES B. EADS estate, expects to soon commence the construction of the works necessary to close the cut.

The work will consist of a brush and pile dam to close the crevasse, with several short wing-dams along the channel side to produce a deposit of sediment and build up a channel bank similar to that existing before the break occurred.

Railway Earnings for Six Months.

The following abstract from an article in the *Financial Chronicle* gives some interesting figures showing the results of railway operations in the United States for the first six months of 1891. The figures, considering the promptness with which they are published, are quite comprehensive, and give a fair index of the railway system of the country. Of the 182 companies reporting, 10 report for five months only. The length of road operated by these 182 companies is 110,365 miles, or about two-thirds of the total mileage of the country. Four of these, however, viz., the Grand Trunk, Canadian Pacific, Mexican Central and Mexican National, lie wholly or partly outside of the United States.

The following table gives the gross and net earnings by months as compared with the corresponding periods of 1890:

Months and No. of roads.	Gross earnings.			Net earnings.		
	1891.	1890.	P. C. Inc.	1891.	1890.	P.C. Inc.
Jan. (125)	50,066,280	46,208,836	8.35	13,972,540	12,464,056	12. 1
Feb. (118)	45,317,064	43,484,394	4.21	12,346,957	11,492,857	7.43
March (140)	53,049,806	52,656,175	0.75	16,036,284	15,929,322	0.67
April (135)	52,987,642	52,901,036	0 16	15,906,246	15,381.672	3.41
May (131)	53,440 399	55,343,271	—3.44	16,783,884	17,390,666	—3.49
June (128)	50,519,690	48,387,290	4.41	15,800,359	14,077,053	12.2
	387,698,261	380,381,063	1.92	270,780,708	267,049,142	3.16

It is seen from this table that the results for the 6 months have not only been favorable, but that each separate month, with the exception of May, shows an increase. These results have not been unexpected to those who have followed the course of railway earnings as published from time to time, but nevertheless they are very gratifying, considering the many adverse conditions, and are quite contrary to the prophecies to which the unpromising outlook at the beginning of the year gave rise. In addition, the comparison is made with the very heavy earnings of 1890.

The following table shows the earnings for 6 months by groups of roads:

Group.	Gross earnings.		Net earnings.		Inc. or Dec.. P. C.
	1891.	1890.	1891.	1890.	
Trunk.....(12)	$ 111,106,252	$ 111,344,481	$ 33,108,916	$ 32,797,675	I. 0.95
Mid. W'n...(26)	21,103,631	20,112,206	5,736,258	5,872,427	D. 2.32
Nor'w'n.....(14)	34,998,114	36,229,469	19,881,064	11,068,370	I. 1.85
So'w'n .....(9)	26,946,407	26,436,577	7,657,093	8,276,698	D. 7.48
Pac.....(20)	54,466,420	52,842,949	17,285,441	14,899,865	I. 16.01
So'n r'ds....(35)	38,933,718	36,881,264	12,574,240	10,958,895	I. 14.76
Coal co.'s..(17)	38,570,358	36,906,727	10,994,071	10,833,839	I. 1.48
E'n & Mid...(37)	33,082,810	32,021,392	9,650,175	9,867,735	D. 2.22
Mex'n.. .....(3)	5,466,843	5,008,650	1,899,321	1,427,713	I. 26.73
Tot.....(172)	364,587,548	357,835,715	109,696,581	106,022,656	I. 3.47
5 mos.....(10)	23,110,713	22,545,348	7,220,972	7,307,266	D. 1.21
Gd. tot .....(182)	387,698,261	380,381,063	116,817,553	113,331,921	I. 3.16

From this it is seen that the Pacific and Southern groups show the largest gains in net earnings, viz., 16.01% and 14.76% respectively, and the Trunk lines the smallest, only 0.95%. Excluding the two Mexican roads, only one other group, the Coal roads, shows an increase. All the others exhibit losses varying from 7.48% to 1.85% in net.

Considering the various systems separately it is found that there is a considerable irregularity in their returns. Sixteen companies show gains in net of over $170,000 each, and eight companies show losses greater than $157,000 each. The Southern Pacific Co. shows the largest gain, $1,643,699, and the Chicago, Burlington & Quincy R. R. the greatest loss, $573,999. Of the total 182 roads, 63 report decreases and 119 report increases in gross earnings, and 82 roads report decreases and 100 gains in net earnings.

Underdrains for Roads.

The following is an extract from the specifications for the improvement of roads at Lenox, Mass., of which Mr. W. S. BACOT, M. Am. Soc. C. E., of New York, N. Y., is the engineer. The form and construction of the underdrains are shown in the accompanying cut.

Underdrains.

Underdrains, if found necessary, shall be constructed wherever and whenever the engineer shall decide, at the expense of the contractor, and shall consist, unless otherwise ordered, of the best quality of 3, 4 or 6-in. unglazed earthenware drain pipe laid with open joints with collars. The joints to be loosely filled with such packing as may be directed; to be carefully laid according to a true line and uniform grade furnished by the engineer and indicated by suitable stakes for the purpose. Where soft ground is encountered, not affording a firm bearing for the pipe, a hemlock board 1 in. thick and 6 to 10 ins. wide must be laid lengthwise under the same; also thin blocks between the collars to afford a bearing to the pipe. The pipe shall be laid to such depth as may be prescribed in each case by the engineer, the trench to be of such form as is indicated on the accompanying drawings.

After the pipe has been properly laid and inspected, the trench shall be filled with cobblestones carefully packed to a height of at least 18 ins. above the top of the pipe, in such manner as is shown on the drawings, or as may be further directed by the engineer. The surface of the stone is then to be covered with a bed of cut sods not less than 1½ ins. thick, rammed to place, above which a filling of dry gravel is to be made to the general level of the roadbed, laid in courses not more than 4 ins. in thickness. Outlet connections for the drains shall be made according to the directions of the engineer.

Abt Rack-Railways in the World.

Among the "Abstracts of Papers" of the Institution of Civil Engineers is one from *Le Genie Civil*, giving a list of the principal lines upon which the Abt system of rack-rail is used. It is interesting as a *résumé* of dates, locations and figures, and we give it as follows:

1. The Hartz line (Brunswick), ordinary gage. Length, 18.9 miles, of which 4.34 miles are provided with rack upon eleven sections of lengths, varying between 272 yds. and 1,690 yds., with grades of 4.5 and 6%. This line has been working since 1885.

2. The Erzberg iron mines (Austria, on the Eisenerz-Vordenberg line), ordinary gage. Length, 12.4 miles, of which 9 miles are provided with rack-grades of 7.1% on the straight, and of 6.5% on curves of 196 yds. radius, two rack plates, three driving axles; load drawn, 100-120 tons minimum. Began work this year.

3. Visp to Zermatt, for tourists, metre gauge. Two rack plates of 0.78 to 0.97 in. thick, according to grade; two driving axles; grades of 12.5%, mounted by trains of 45 tons, curves 65 yds. radius.

4. Mendoza to Santa Rosa (South America). In construction, to be finished in 1892. Crossing the Andes, connecting Buenos Ayres and Valparaiso. Metre gauge; length of the part in the mountains, 64 miles; 17.3 miles fitted with rack-grades of 8%, and radii of 125 yds.

5. Diacophto to Kalavryta (Greece). Gage 29.9 ins., grades of 14.5%, curves of 87 yds. radius. Rack composed of two plates 0.62 in. thick, three driving axles; load

ELEMENTS OF WEATHER IN THE UNITED STATES, OF MOST INTEREST TO ENGINEERS, FOR THE MONTH OF JULY, 1891.

[Furnished to ENGINEERING NEWS by the Department of Agriculture.]

	STATION.	Temperature. (Deg. Fah.)				Wind.			Precipitation — Rain and melted snow. Inches.		
						Velocity in miles per hour.					
		Average.	Max.	Min.	Range.	Average.	Maxim.	Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.	Northfield, Vt.	63.0	87	40	47	8.2	30	S	3.20	0.97	16
	Portland, Me.	65.0	91	52	39	8.0	27	SE	4.78	1.42	14
	New York City	70.8	89	58	31	9.5	31	SE	4.11	1.02	15
	Pittsburg, Pa.	70.0	89	52	37	4.8	20	NW	7.65	1.69	17
	Chicago, Ill.	67.0	87	55	32	13.0	50	SW	2.47	1.28	8
	Omaha, Neb.	71.2	90	51	39	7.1	30	SE	3.54	1.35	15
	St. Paul, Minn.	65.7	84	47	37	6.6	25	SE	2.07	1.30	9
	Duluth, Minn.	61.3	84	47	37	6.2	34	NW	3.82	1.50	13
	Bismarck, N. Dak.	64.8	86	41	45	9.0	48	NW	4.29	1.85	13
	Average	66.5	87.4	49.2	38.2	8.0	32.8	.....	3.98	1.37	13
SOUTHERN CITIES.	Washington City	72.0	89	54	35	5.0	31	NW	8.40	2.31	16
	Louisville, Ky.	74.0	92	56	36	5.6	26	NW	4.08	1.64	10
	St. Louis, Mo.	74.9	91	55	36	9.1	35	SW	1.50	1.07	6
	Savannah, Ga.	79.5	94	64	30	6.8	24	NE	9.70	2.09	18
	Leavenworth, Kan.	...	...	...	...	...	...	.....	...	...	...
	Jacksonville, Fla.	81.2	95	65	29	7.3	33	SW	4.08	1.96	16
	Chattanooga, Tenn.	75.4	91	59	32	4.2	29	SW	6.18	2.18	11
	New Orleans, La.	79.9	92	68	24	7.0	36	SE	4.57	1.45	18
	Memphis, Tenn.	77.0	94	58	36	5.4	24	SE	6.06	3.56	14
	Palestine, Tex.	80.2	93	64	32	5.1	19	NE	2.89	0.98	7
	Average	77.1	92.7	60.4	32.3	6.2	28.9	.....	5.27	1.92	13
WESTERN CITIES.	Helena, Mont.	...	...	...	...	...	...	.....	0.22	0.11	4
	Port Angeles, Wash.	57.3	81	40	41	3.8	11	W	0.10	0.09	2
	San Francisco, Cal.	59.4	81	50	31	11.7	34	SW	0.47	0.34	4
	Salt Lake City, Utah	73.3	98	45	53	4.9	28	SE	0.59	0.22	6
	Denver, Col.	69.0	93	51	42	6.5	44	NE	0.04	0.04	1
	Yuma, Ariz.	92.0	114	64	50	6.4	30	SW	0.84	0.42	9
	Santa Fé, N. Mex.	69.2	87	52	35	7.2	36	SE	0.38	0.20	4
	Average	70.0	92.3	50.3	42.0	6.8	30.8	.....			

drawn, 15 tons at 9.3 miles per hour on grades 3.5% without racks and at a speed of 3.1 to 6.2 miles at grades of 14.5% with racks, line being partially worked.

6. State railways in Bosnia and Herzegovina. Length 42 miles, of which 12 miles are fitted with rack of two plates in six sections; grades of 3 to 6%; three driving axles. Each locomotive draws a train of 70 tons up a grade of 6%. Working already begun and to be completed this summer.

7. Central Dominican at Puerto-Plata, Saint Dominic. Now being built to Santiago. Grades of 2% with curves of 109 yds. radius, gage 29.5 ins. Load drawn, 50 tons at 9.3 miles per hour on grades of 4%, and 4.3 miles per hour on grades of 5%.

8. Monte Generoso (Switzerland). Tourist line; 5.6 miles of rack; gage 31 ins.; grades from 0 to 22%, with curves of 65 yds.; two plates in the rack and 2 driving axles. Each engine draws a carriage with 56 passengers.

9. Rothhorn. Similar to No. 8.

10. Glion Ry. Similar to No. 8 and No. 9.

11. Puerto Cabello to Valencia (Venezuela). Metre gage; grades of 8%; radii of 125 yds.; rack of 3 plates 0.85 in. thick; 2 driving axles, and load of 60 tons drawn on a grade of 8%.

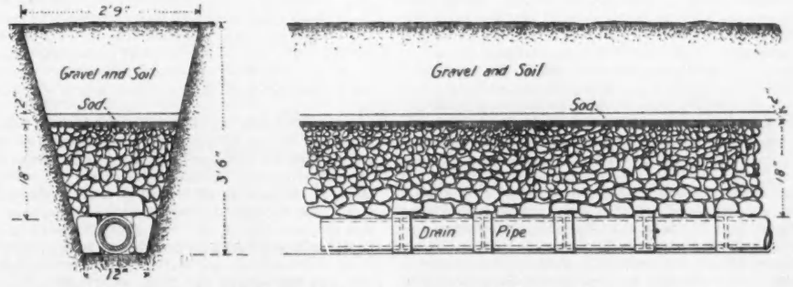
12. Manitou to Pikes Peak (Colorado, U. S. A.). Tourist line, starting at an elevation of 6,560 ft., and reaching an altitude of 14,170 ft., being 2,360 ft. above the limit of vegetation. Fitted with rack for a distance of 9 miles; grades of 0 to 25%; radii of 122 yds.; 2 plates of 0.78 to 1.25 in. thick; 3 driving axles; ordinary gage; mean speed 5 miles and a minimum speed of 3.1 miles per hour.

13. Electric railway upon Mount Salève; metre gage; grades of 25% with curves of 65 yds. radius, length 5.6 miles; rack of 2 plates, 0.63 in. thick. Working for construction purposes will commence this summer, and the regular service next year.

14. Aix-les-Bains to Revard. This will be the first mountain railway constructed in France. The opening will take place in June, 1892; all the metal work will arrive in August. Metre gage; length 5.7 miles; fitted with rack the whole distance of two plates 0.97 in. thick. Each locomotive will pull a carriage containing 60 passengers.

15. De Veyrier to the peaks of Mont Salève (Franco-Swiss neutral ground). Line not yet begun.

16. Lastly, the line from Cluses to Martigny, via Chamounix, the construction of which has been recently authorized and the works will be begun immediately.



Underdrains for Roads; Lenox, Mass. W. S. Bacot, M. Am. Soc. C. E., Engineer.

The system is thus becoming largely used, about 247 miles being constructed, of which 121 miles are fitted with rack.

The lines referred to as 5, 7, 14, 15 and 16 have been or are to be built by the Cail Co.

Experiments were recently made upon a special track 130 yds. long upon ground on the Quai de Grenelle, the line representing the most difficult features which would be met with in practice. The train starts on the level for a few yds., an incline of 35%, with a curve of 35 yds. radius; is then descended by means of the rack; this is followed by a straight level portion leading to a grade of 14.5%, combined with a curve of 110 yds. radius. The rolling stock, which was successfully tested, is intended for use on the line between Diacophto and Kalavryta.

PERSONALS.

Mr. GEO. H. PAINE has been appointed General Agent of the Union Switch & Signal Co., Swissvale, Pa.

Mr. JOHN F. MUNRO, C. E., of Detroit, Mich., who was for some years county engineer, died recently at the age of 84.

Mr. N. O. WHITNEY, Chief Engineer of the Pittsburg, Fort Wayne & Chicago R. R., has resigned his position to accept that of Professor of Civil Engineering in the University of Wisconsin, Madison, Wis. Mr. WHITNEY was engaged for 14 years in railway location and construction in the West, and has had other extensive experience.

Mr. JOHN ERBELDING, who died recently at Brooklyn, N. Y., was an engineer of some experience. He was born in Bavaria in 1826, and was engaged on the construction of several railways in France and Switzerland, until the Franco-Prussian war, when he came to this country. Here he was employed on the Calumet copper mines in northern Michigan, and later on the Long Island R. R.

Mr. DENNIS O'BRIEN, Supervisor of Subdivision No. 1, of the Pittsburg Division of the Pittsburg, Cincinnati, Chicago & St. Louis R. R., died Aug. 22, at Mansfield Valley, Pa., aged 38 years. Mr. O'BRIEN was connected with the Roadway Department of the "Pan-Handle" system from boyhood, and had held the most difficult Supervisor's Division for the past 15 years.

MR. CHARLES F. STOWELL, M. Am. Soc. C. E., Bridge Engineer of the New York State Railway Commission and long engaged in investigating the status of bridges in this State, has opened an office as a consulting engineer in Albany, N. Y. His especial field will be the design of bridges and roofs, inspection of structural iron and steel, and superintendence of construction or repairs of bridges and buildings.

Mr. WALTER L. BRAGG, of Montgomery, Ala., one of the members of the Interstate Commerce Commission, died at Spring Lake, N. J., Aug. 21. In March, 1881, he was elected president of the Alabama Railroad Commission by the Legislature, to which office he was again elected in 1883, his second term expiring in March, 1885. In January, 1889, Mr. BRAGG was appointed an Interstate Commerce Commissioner by President Cleveland.

NEW PUBLICATIONS.

Wire.—A treatise upon its manufacture and uses, embracing comprehensive descriptions of the construction and applications of wire ropes. J. BUCKNALL SMITH, C. E., author of "Cable Traction as Applied to the Working of Rail and Tramways," "Rope Haulage in Mines," "The Diamond Mining Industry of South Africa," etc. Published by "Engineering," London, and John Wiley & Sons, New York, 1891. Large 8vo, pp. 347, many cuts, diagrams and folding plates and tables.

This handsome work, on a subject never before treated so much in detail, to our knowledge, commences with the antiquity of the manufacture of wire. Gold wire is mentioned in connection with the sacerdotal robes of AARON; metallic shreds have been found supposed to date as far back as 1700 B. C., and wire made by the Ninevites, 800 B. C., is exhibited in the British Museum. This ancient wire, through the Greek and Roman periods and up to the 14th century, was produced by hammering out strips of metal and not by "drawing," as practiced now. In the middle ages this industry was extensively pursued and it is fairly established that the method of drawing wire was practiced in the Lenn district of Germany during the 14th century. It was not, however, until about 1365 that machine-drawn wire was produced in England by a Saxon, C. SCHULTZ, and a CALEB BELL, an Englishman who learned his art abroad. BELL supplied Queen ELIZABETH with toilet pins made in a mill driven by water power. In 1630 the home industry in wire-drawing had been so firmly established that CHARLES I. prohibited further imports of foreign wire. In 1633 the first mechanical wire mill proper was built in England, at Sheen, near Richmond, and from this date the industry maintained a substantial footing and progressed in its development.

After a most interesting historical introductory, the manufacture and multitudinous uses of iron and steel wire and wire made of copper, bronze, brass, silver, etc., follow. These chapters we cannot follow out here, but that one on wire gages, etc., will be novel to many readers. According to the author the first definite gage, or "size" for measuring the diameter of wire was described in LEWIS' "Philosophical Commerce of Art," published in 1745, and consisted of a brass plate provided with step-like notches. Prior to 1842 there were only 26 sizes, and the mixture and confusion of gages used between 1826 and 1881 is given in a separate table expressed in 100ths of an inch. STUBS, of Washington, in 1843, commenced to gage his wire by "mils," and this system was followed, in 1857, by Sir JOSEPH WHITWORTH. In 1867 LATIMER CLARKE, M. I. C. E., read a paper on the "Birmingham Wire Gage," and later proposed the adoption of his amended system. In 1877 a special committee of the American Institute of Mining Engineers proposed to abandon numbers for expressing certain sizes, and to adopt a gage graduated according to thousandths of an inch, as determined by a micrometer. This committee found that all then existing wire gages were only approximately correct, and differed perceptibly with the makers. The French and Germans settled upon a standard based upon the millimetre; and the adoption of this standard was strongly agitated in England and America by some investigators. In 1882-83 meetings were held by iron and steel manufacturers with a view of discussing this important question, and arriving at some practical solution of a vexatious problem; and in February, 1883, the "Im-

perial Standard Wire Gage" was mutually agreed upon by English makers. The Germans still adhere to the millimetre, and the American wire makers usually designate their gages by appending the name of the maker, but these gages are nearly all precisely similar to Roebling's and Washburn-Moen standards, now generally known as the "National wire-gage." But even in England, with only one legally recognized scale, some engineers and manufacturers still quote Birmingham and other obsolete gages, and the result is a confusion in catalogues and specifications. As showing some of the differences between the English "standard" and the American gages, we abstract from a long comparative table a few of the figures, as follows, expressed in thousandths of inches:

"National" No. U. S. A.	Roebling & Washburn-Moen gage. In.	Brown & Sharp gage. In.	Equivalents in English "standard" gage. In.
000000	.46	.....	.464
0000	.393	.46	.4
1	.283	.2893	.3
5	.207	.18194	.212
10	.135	.10189	.128
20	.032	.03196	.036
30	.014	.01002	.0124
35	.0095	.00561	.0084

A chapter now follows on electrical conductors, one of the most important modern uses of wire, and dating practically from the investigations of Sir WILLIAM THOMSON in 1856. Mr. LAZARE WELLER not long ago presented to the Société Internationale des Electricians the results of experiments upon the electrical conductivity of certain metals and alloys, and we append from this long list some of the better known, as follows:

Pure silver	100 00
Pure copper	100.00
Refined and crystallized copper	99.9
Telegraphic silicious bronze	98.00
Alloy of silver and copper (50%)	86.65
Pure gold	78.00
Pure aluminum	54.20
Tin, with 42% sodium	46.90
Pure zinc	29.90
Brass, with 35% zinc	21.50
Phosphor tin	17.70
Swedish wire	16.00
Pure Banca tin	15.45
Siemen's steel	12.00
Pure platinum	10.60
Copper, with 10% nickel	10.60
Pure lead	8 88
Bronze, with 20% tin	8.40
Pure nickel	7.99
Phosphor bronze, 10% tin	6.50
Antimony	3.88

The author then deals with the manufacture of iron and steel telegraph wire, and the galvanizing protective process, at a length that cannot be intelligently given in abstract.

The manufacture and use of wire rope forms the subject of another exceedingly valuable chapter, commencing with its first product in that form by German makers in 1821, and used in the Geneva suspension bridge. But these first wire ropes were, however, simply series of parallel wire strands bound together by an external serving of finer wire. But shortly after that date Germany made "formed or stranded" wire rope, from charcoal iron exclusively. One ALBERT of Clausthal is universally accepted as the true inventor of this type of rope in 1834; though J. WILSON, of Derby, lays claim to having made stranded wire rope in 1832 for the Haydock Collieries, in Lancashire. The manufacture of wire rope is given in full and most interesting detail.

The 6th chapter, on some applications of wire rope, treats of underground haulage, etc., and illustrates by descriptions of endless rope, endless chain and main and tail rope systems of use. Rope driving machinery comes under this heading, as well as appliances for gripping cars, lubricating devices, etc. Aerial ropeways are among the latest and most useful applications of wire rope to engineering uses, and the Otto, one of the longest known systems, is fully described, and will be found in our own issue of July 25, 1891, in connection with the Garrucha mines of Spain. Rope haulage in the African diamond mines is also described. Wire rope as used for traction purposes on the Brooklyn Bridge, and as applied in the erection of the Forth Bridge, is treated of. Wire netting and wire fencing, their manufacture and their uses, form the concluding chapters of a work that teems with interesting and useful information. While this work is by an English author, the United States receives full credit for the enormous manufacture and consumption of wire in this country. Messrs. Roebling & Sons, of Trenton, commenced business in 1849, and the Washburn & Moen Co. is credited with making wire 18 years previously, and both companies are frequently referred to in terms of the highest commendation. It was an American, Mr. L. W. Wright, who in 1824 invented the pin-making machine that now turns out in Birmingham and a few other places in England "50,000,000 pins daily." In the use of wire for telegraphic purposes, fencing, piano-making, bridges, traction, etc., the United States is ranked first among the nations of the world.

—*Engineering Notes from England.* JOHN C. TRAUTWINE, Jr. Paper, 6 x 9¼ ins., pp. 12

This is a reprint of a paper read before the Engineer's Club of Philadelphia in March, 1889.

—*Final Report of the Board of Sewer Commissioners of Brockville, Ont., with Report of Chief Engineer,* 1887-1891.—Paper, 8½ × 5¾ ins., pp. 82.

The commissioners' report gives the history of the sewerage system, and the character of the system is described by Mr. WILLIS CHIPMAN, Chief Engineer. A report by Col. J. E. WARING is appended.

—*L'Unification des Heures, Situation Actuelle.* L. DE BUSSCHERE, Brussels, Belgium, 1891. Paper, 6 x 9 ins., pp. 61.

This paper on "Uniform Standard Time" is more extended and complete than the paper by the same author, noticed in our issue of Aug. 15, and gives a review of the present situation of this question in general, with particulars of the progress made in different countries.

TRADE PUBLICATIONS.

—*Phœnix Column Construction as Adapted for Buildings.* MILLIKEN BROS., New York and Chicago. Paper. 10¾ x 6¾ ins., numerous plates and photo type illustrations

This is a handsomely got up pamphlet giving notes on the modern practice for metallic columns in buildings, with sections and dimensions of Phœnix columns, and a set of valuable tables of the allowable working loads for these columns, both for iron and steel. The plates give details of connections, etc., and there are a number of good illustrations of work in progress.

SOCIETY PROCEEDINGS.

International Congress of Hygiene and Demography.

[FROM OUR LONDON CORRESPONDENT.]

(*Continued from page* 164.)

On the conclusion of this paper, Professor PACHIOTTI started off in French to express his appreciation of English hospitality, but it suddenly occurred to him that English would better please his audience when he came to the subject for which he was noted, viz.: "The Drainage of Towns in Italy." They had, he said, been much behindhand in Italy, but, now that politics were pretty quiet more attention was being paid to sanitary matters. Turin had furnished a good example, and he discussed the relative advantages of the "separate system" of drainage and of that advocated under the title of *le tout a l'égout*. His conclusions were that every town should select that system of sewage disposal which was best adapted to its own circumstances, since there was no one system universally applicable; that the *tout a l'égout* system most nearly approached perfection, and should be adopted by all towns possessing ample water supply and appropriate gradients; that towns possessing suitable soil in or near to their immediate neighborhood should establish sewage farms for the purification of their sewage and to the advantage of agriculture; and that, unless absolutely unavoidable, sewage should never be allowed to flow into the watercourses in or near towns, since chemical and bacteriological investigations showed that such a practice produced pollution of the water strictly comparable to that by fouling from cesspools.

The question of "Sanitation in India" was next dealt with by Mr. BALDWIN LATHAM, M. Inst. C. E., M. Inst. M. E. No country, he said, required greater attention to sanitary matters than India, where the disposal of solid sewage was often the cause of a serious nuisance and danger to health, as polluting the underground water, the soil and the atmosphere in the neighborhood of cities. The water supply, except in the case of some of the large cities, was extremely defective, the principal supply being taken from tanks or local wells liable to pollution, and this was the main cause of cholera in India. Neither water supply nor sewerage alone would produce the benefit of good health, but the two should be combined in order to bring about the highest state of healthiness. It is stated that the sanitary commissioners of India were fully alive to the importance of fresh sanitary measures, and aided, as they were, by the supreme authority of the governments of various provinces, it was hoped that in the course of a few years much would be done to mitigate the evils arising from the unsanitary state of large towns and of the country generally.

MR. J. A. LEMON compared "French and English Systems of Sewage" He complained generally of the French system, in which it was a common practice to discharge the polluted water from houses into the gutters of streets. The principle adopted was described as carrying everything from the streets to the sewer, and as little as possible from the houses, while the English system in general use was the entire removal of excrementitious matters from the house before decomposition set in. The English water-closet was recommended as the cleanest and best receptacle, and in connection therewith the water-carriage system. Opponents of the English method said that it increased difficulties at the outfall, but the same difficulties arose in France from decomposed sewage from cesspits discharged into sewers. In English towns similarly situated to French towns, the death rate was much lower, in some cases less than half. This might arise from other causes than sewerage, but in the opinion of the author, good sewerage and house drainage played an important part in the rate of mortality"

The secretary or "lecturer," Mr. R. E. MIDDLETON, M. Inst. C. E., read a paper on "The Removal of Sewage After Leaving Buildings," in which he gave a short description of different systems for the removal of sewage matter from houses and streets to the sea, land, or otherwise. The systems which had been tried were the earth system, the pail system, the system of sealed cesspits and the separate system. The most important of the proposals was that of separating the sewage proper from the storm water, returning the latter to the nearest watercourse, and only transporting the former to a distance where it might be treated on land chemically, by precipitation, by electricity, or by two or more of the systems combined, the effluent being then returned to the watercourse. The advantages which the separate system appeared to offer were: the use of very small sewers, a fair amount of regularity in the amount of sewage passing through the sewers, which would not vary greatly either in quantity or quality; that the gradients could be arranged to give a minimum rate of flow which should not allow of deposit; that where pumping had to be employed, the volume to be pumped was reduced to a regular dirurnal unit; that the comparatively small alteration of level of the sewage matter in the sewers and the fact that the variation in the rate of flow would be reduced, and the average rate made higher, should tend to prevent pressure or the evolution of gases, and should shorten the time of delivery, and, therefore, that in which fermentation could take place and should tend to health; that the heavier matter, such as road scrapings, coal dust, etc., was not passed into the sewers, but into the water courses, and the former should therefore be kept free from deposit with great ease, and that from the small size of the sewers and the comparatively regular flow into them they offered great facilities for more thorough and regular ventilation than had hitherto been found possible in large sewers. Mr. MIDDLETON emphasized the necessity for treating each place on its own merits and for avoiding the adoption of one stereotyped system in all cases.

A new mining district is very often of mushroom growth, and sanitation has been neglected in some cases with disastrous results. Some interesting information was given by Mr. A. MAULT, Engineering Inspector of the Central Board of Health, Tasmania, on "The Sanitation of a Mining Settlement." It appeared that the Mount Zeehan silver lead mines on the west coast of Tasmania were drawing a large population, the numbers having increased from 400 to 4,000 in six months. It being impracticable to constitute a municipality under the present law without interfering with mining, the government had carried out the more urgent work. The first work done was to clear out, straighten and lower the beds of the streams. This reduced the level of the "ground water" and permitted the land drainage of the swamps. Sewers were then constructed of sheet iron pipes, coated with pitch and tar. Every householder was required to properly drain his premises on a given plan. As the streams were already poisoned with lead washing, the outfalls of the sewers were only placed sufficiently far away to avoid nuisance, and the sewage is not at present purified before discharge. The work done is in part temporary. When the Zeehan Ry. is completed, better means will be available.

In the discussion on these papers which followed Col. ALFRED JONES advocated the separation of sewage and rainfall. He also approved of the employment of compressed air instead of hydraulic power for lifting purposes in connection with sewage works. M. G. BECHMANN said that the "French" system of sewage described was not only French but was generally adopted on the Continent. However, French towns, notably Marseilles, were adopting improved methods, but they labored under the disadvantage of not being as wealthy as English cities. After a few remarks from Mr. REID it was stated by Mr. ANDREWS that he had carried out works in Victoria in connection with a camp, and found wooden conduits preferable to iron pipes for the conveyance of sewage. Mr. GILBERT THOMSON was in favor of letting the water from roofs mix with the sewage, and to convey the rainfall from the streets separately. In small towns the streets were of the nature of country roads and the drainage therefrom did not contain offensive matter. Mr. JAMES THOMSON, on the other hand, thought that the separate system had dangers. Herr SYMONS, of Rotterdam, stated that a sulphuric ammonia process had been adopted in Amsterdam and been productive of considerable economy. After Mr. BUCHAN had supported the views of Mr. J. THOMSON, Mr. MAULT said that in Tasmania they had the best wood in the world for the construction of sewers, but he preferred iron, as grease, etc., was far more liable to deposit itself upon wood. Mr. B. LATHAM believed that the water closet system could be advantageously introduced into eastern countries, and he mentioned incidentally that some rivers freed themselves from pollution to a great extent. Sewage farms proved an admirable way of disposing of sewage, and many were in successful operation. Where old sewers existed and new ones were laid down, the former could be well employed for the conveyance of the rainfall. Mr. LEMON, in replying to some of the observations made, admitted that the sanitary arrangements in France were being changed for the better. Some variety was im-

parted to the proceedings by Professor MEIJER, of Utrecht, who asserted that the "*tout a l'égout*" system and the separate system are noxious in the town itself, as proper ventilation is impossible so long as houses are of different heights and street ventilation is not given up; that it was impossible to get rid of the deposits in the sewers; that the danger to health is not in all parts of house refuse, but in the excremental portions only, and that the Leinur system was the only good one from a sanitary point of view.

A paper then came by Mr. W. SANTO CRIMP, on Sewer Ventilation. He said that the question of sewer ventilation was one of great difficulty owing to the varying conditions. It had been generally assumed that temperature was practically the only agent causing movements of sewer air, an assumption greatly wanting in basis. As a result of this theory it had been widely believed that sewer air constantly passes from the lower parts of a drainage system to the higher, to the discomfort of the inhabitants of the higher part of the district sewer. As a matter of fact, the sewer air as often passed down hill as the reverse way. According to the results of his observations on the new Wimbledon sewers and more recently upon the Metropolitan sewers, the wind was practically the only agent producing movements of sewer air that can be measured by an anemometer. Strong winds produce rapid movements of sewer air, while in calm weather opposite conditions prevailed. The result of the authors' observations were formulated as follows: (1) The wind is the only agent which produces measurable movements of sewer air in an ordinary system of sewers. (2) The fullest use of the wind should be made in effecting the ventilation of sewers. (3) The offensiveness of sewer air should be lessened to the fullest practicable extent by systematic flushing and cleansing of the sewers and by keeping them structurally in a thoroughly effective condition. (4) Small pipe sewers need not be ventilated to the same extent as those large enough to admit of men working in them, vents high overhead being alone required. (5) In all systems were practicable ventilating pipes should be carried up high buildings or other objects, where they may discharge their foul contents into the atmosphere, and street ventilators should be reduced to a minimum. (6) If every house were properly drained and proof against sewer air, ventilation of sewers, as ordinarily practiced, would be unnecessary.

"Sewers and Drain Ventilation," was the title of the next paper, the author of which was MR. R. READ, A. M., Inst. C. E. He stated that the space above the sewage is always filled up with air, watery vapor or gas, or with a mixture of least two of these. The motions of sewer air were produced by compression, expansion, diffusion, differences of temperature and barometric pressure, and could not be measured by an anemometer. The wind was the most powerful force in producing motion in the sewer air. Nearly all attempts to maintain a constant current of air flowing in one direction had failed, because they could not be in harmony with the forces at work. There could be no true ventilation without a system of both inlets and outlets. The street gratings should be comparatively small to always act as inlets, and the outlets should always be above the roofs of the houses and much more numerous than the inlets. The true object of ventilation was to entirely prevent the formation of gases. Ventilation was not the cause of foul gases and could not increase the quantity. To deal with foul gases from decomposing deposit was to treat the symptoms instead of the disease.

(To be continued.)

The Scandinavian Engineering Society.—Chicago. Meeting of Aug. 20. Mr. Karl L. Lehmann read the first part of an interesting paper on "Wind-bracing in Buildings." It will be continued at the next regular meeting of Sept. 17, and discussions will follow later.

American Association for the Advancement of Science.—Meeting at Washington, D. C.—The section of mechanical science and engineering held its first meeting Aug. 21, when papers were read as follows; "Economy Produced by the Use of Water as a Fine Spray into Air Compressors," and a "Note on the Efficiency of the Screw Propeller," by Prof. James E. Denton; "Experimental Results Obtained with a New Form of Direct Action Propeller," by Prof. Todd. Government timber tests were commented upon by Mr. B. E. Fernow, and Prof. J. B. Johnson read a paper upon the "U. S. Tests of Strength of American Woods made at the Washington University Testing Laboratory, St. Louis." Other papers read before the engineering section were: "The Crushing of Short Prisms of Homogeneous Material, by Charles L. Bouton; "A method of Holding Samples of Wood and Brick for Determination of Tensile Strength," by Prof. Denton, "Expansion of Steam Calorimeters," by Prof. Thomas Gray; and "Maximum Error Due to Neglecting the Radiation Correction of a Barrus Calorimeter," by D. S. Jacobus.

Prof. Gray also read a paper on "Tests of Electric Railway Plants," describing the apparatus and methods used in electric railway tests in Terre Haute, Ind. He gave details as to the total horse power used, the power lost, variations and power required per car. Prof. Wm. Kent, of New York, presented a paper on the "Opportunity for Chemical Research at the World's Fair." He said that tests made at the centennial had proved of great service to the engineering profession in establishing the limits of efficiency to be expected in steam boilers. Large expositions afforded unusual opportunities for mechanical tests, because there the best examples of various varieties of appliances, were grouped together, making comparisons easy and accurate, the tests all being made under practically uniform conditions. Prof. Kent said he had brought to the attention of the World's Fair people the advisability of making tests of fuels, furnaces, engines, pumps, etc., and hoped his suggestion would be adopted. He advocated the appointment of a committee to look after the matter. Prof. D. S. Jacobus also read a paper showing the inferiority of carbonic acid as the working fluid of refrigerating machines, the ammonia process being much superior.

Other papers read before this section were:

"Maximum Error Due to Neglecting Radiation Correction of a Barrus Universal Calorimeter," D. S. Jacobus, assistant professor of experimental mechanics, Stevens' Institute of Technology." "Relative Value of Carbonic Acid as the Working Fluid in Refrigerating Machines," D. S. Jacobus. "Relative Commercial Economy of Compound and Triple Expansion Engines," J. E. Denton. "On the Method of Applying Tensile Strains to Wood and Brick Tested for Determination of Tensile Strength," J. E. Denton. "On the Expansion Steam Calorimeter," Thomas Gray, professor of dynamic engineering, Rose Polytechnic Institute, Terre Haute. "Methods of Testing Power Required for Electric Railways," Thomas Gray. "Note on Power Required for Cutting of Metals," Thomas Gray. "Results of Recent Tests of the Efficiency of the Steam Jackets of the Fawtucket Pumping Engine," Wm. Kent, New York. "Laws of Failure of Materials in Compression," Chas. Bouton, St. Louis.

DR. J. W. Le CONTE, of the University of California, has been selected by the nominating committee to succeed Prof. ALBERT BENJAMIN PRESCOTT as President for the next year. Dr. Le CONTE was born in Georgia Feb. 26, 1823; was graduated from the University of Georgia in 1841, and the College of Physicians and Surgeons, in New York, in 1845. He was later a student of AGASSIZ at Harvard, in geology and sciences, and has made geology his life-work.

New England Roadmasters' Association—*(Concluded from page 165).*—The second day of the convention opened at 9 A. M. on Thursday, Aug. 20. The first subject taken up was the report upon the allowable wear of engine driving wheel tires before general economy demanded their repair.

The report detailed at some length the damage done to frogs, switches and the track in general by badly worn tires of locomotive driving wheels, and stated that the limit of wear should be ¼ in. from the proper bevel of the wheel, as recommended by the Superintendents of Motive Power, as the standard, and that it should never exceed ⅜ in. It did not consider it safe to run locomotives having a greater wear.

The discussion was opened by Mr. J. W. Shanks. He regarded this as one of the most important questions with which the association had to deal, and considered that ¼ in. wear was the extreme limit to which such wear should be allowed. He would prefer having the cost of turning the tires added to the expenses of the roadmaster's department rather than to have this limit exceeded.

Mr. L. M. Muzzey thought that he would put the limit under ¼ in. On the Boston & Albany R. R. it is the rule to turn all tires as soon as worn ¼ in. There were three reasons why driving wheel tires should be kept as near as possible to standard bevel. First, because of the increased wear and tear of frogs and split switches by rutted tires. Second, because of the increased wear of the rail. Third, when the track was relaid with new rails having a wider head than the old to which the tires were worn there was not a sufficient tire surface in contact with the rail to admit of the locomotive doing its work. There had been trouble from this last cause on the B. & A. R. R., upon putting in the new 95-lb. rail.

Mr. R. P. Collins considered that the limit ought never to exceed ⅜ in., and would prefer to have it less. He thought that it would be money in the pockets of the company to put on the hands necessary to turn all tires before they were worn ⅜ in. Lack of hands in the machine shops was largely the reason why tires were allowed to become so badly worn. His experience was that the driver brake helped to keep the tire in shape

The experience of the several other members who spoke had been practically the same, and little new was added to the above.

The discussion was closed by passing the following resolutions:

Resolved: That it is the sense of this Association that general economy demands that ¼ in. should be the limit of wear of locomotive driving wheel tires.

That the tire should receive attention as soon as the wear has reached $^{3}/_{16}$ in.

The next question taken up was the report of the committee upon Fences, Cattle Guards and Railroad Crossings.

The report recommended for thickly settled districts a vertical board fence 6 ft. high, with molded cap and barbs on top of the cap, the boards to be 6 in. wide and spaced ½ in. apart. For thinly settled districts a braided wire fence with posts 10 ft. apart, and 4 strands of wire 13 in. apart. The committee regarded the surface cattle guard as the best, but recommended no particular form and in regard to grade crossings it was best to do away with them altogether.

The discussion showed considerable diversity of opinion as to what constituted the best fence. Mr. R. P. Collins did not believe in the use of wire fence at all. The Old Colony R. R. used a tight board fence at stations, a post and board fence for less thickly settled places, and in remote pastures a post and rail fence. The surface cattle guards were used, constructed of triangular strips of wood nailed to the ties. For grade crossings spruce plank 16 ft. × 10 in. were used where the traffic was light and a similar pine plank in more thickly settled places. With the same service he regarded pine plank as twice as durable as spruce.

Mr. G. W. Bishop considered the post and board fence as superior to all others. He placed the posts 8 ft. apart and used 16 ft. × 8 in. boards, placing them 8 in. apart. He found it impossible to keep a wire fence up.

Mr. J. W. Shanks stated that there had been recently introduced onto the Central Vermont R. R. a woven wire fence which had given excellent satisfaction under all conditions. The posts are placed 8 ft. apart. He used a wooden slat surface cattle guard. Mr. F. Holbrook also stated that he had used woven wire fencing and was very well satisfied.

Mr. F. S. Sibley preferred a barbed wire fence to a post and board fence, as it lasted longer and its first cost was less. He had about 15 miles of this fence in use and it had given very good service.

Mr. F. C. Clark then introduced the following resolutions, which were passed:

Resolved: That we recommend a post and board fence as better and cheaper than a single wire fence.

That we recommend a careful trial of woven wire as a material for fencing.

That we regard the pit cattle guard as requiring to be replaced by some other form.

That we recommend a trial of the "common sense" tile surface guard and that a report be made upon its merits at a future meeting, and that we also recommend a trial of all forms of surface guards.

That we adopt the report of the committee in regard to railway grade crossings.

The report upon the Best Methods of Holding Rails to Ties Outside of Joints, Holding Gage on Curves, Spikes, Plates, etc., was then taken up. The report was very short and in abstract as follows:

We know of no better method than with good spikes, and for that purpose would recommend the Goldie soft steel spike as being superior to any we know of. For holding gage on curves would recommend that the track be spiked wider than the standard gage, $^{1}/_{8}$ in. for each degree of curvature not to exceed 1 in. We do not believe in braces, except on very sharp curves, where it is impossible to hold the track without them. We cannot speak from experience on tie plates, but think they would be advantageous in prolonging the life of soft-wood ties and holding track to gage on curves.

The discussion was opened by Mr. F. Holbrook, who stated that he did not think the association ought to go on record as committing itself in favor of any particular spike. He used the Servis tie plate on 16° curves and found that they preserved the gage.

Mr. Geo. Nevens stated that he had used the Servis tie plate on the Maine Central R. R. for 6 years and considered them worth their cost to keep the track in gage. He used an 8 × 4 in. plate on cedar ties. The ties had not rotted underneath the plate. For shimming track he considered them superior to anything else.

Mr. G. K. Post said he had put in 3,000 Servis tie plates on curves and was so much pleased with them that he had ordered more for the same purpose.

The discussion was closed by passing the following resolutions:

Resolved: That we recommend the use of the Servis tie plate for economy and preservation of grade.

That track should not be spiked wider than standard gage, except on curves of more than 5°.

That the Goldie soft steel spike has superior merits and that we recommend a continued use of them.

The unfinished business of the convention was then taken up. It was voted to increase the salary of the Secretary and Treasurer to $75 per annum. The next place of meeting will be at Cooley's Hotel, Springfield, Mass. Resolutions of thanks were passed to the supply men and to the respective railway managers for allowing leave of absence and free transportation. The convention was then closed with prayer by the chaplain.

It was generally conceded that this meeting was one of the most successful in the history of the association. The attendance was large, and close attention and great interest were paid to the questions under discussion. The exhibit of the supply men was one of the largest for several years past, and attracted much attention from the members of the Association.

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AND

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GEO. H. FROST.....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Engineers' Club of St. Louis.—Sept. 2. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.
Western Society of Engineers.—Sept. 2. Secy., J. W. Weston, 230 La Salle St., Chicago.
American Society of Civil Engineers.—Sept. 2. Secy., Francis Collingwood, 127 East 23d St., New York.
Engineers' Club of Minneapolis.—Sept. 3. Rooms, Public Library Bldg. Secy., F. W. Cappelen.
Association of Civil Engineers of Dallas.—Sept. 4. Secy., E. K. Smoot, 803 Commerce St.
Technical Society of the Pacific Coast.—Sept. 4. Secy., O. von Geldern, 819 Market St., San Francisco.
American Society of Swedish Engineers.—Sept. 5. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.
Northwest Railroad Club.—Sept. 5. Rooms, Union Station, St. Paul.
Civil Engineers' Society of St. Paul.—Sept. 7. Secy., C. L. Annan.
Engineers' Club of Kansas City.—Sept. 7. Rooms, Baird Building. Secy., H. Goldmark.
National Electric Light Association.—Annual Convention, Sept. 7-12, Montreal, Que.
Atlanta Society of Civil Engineers.—Sept. 8. Secy., Parker N. Black, Room 39, Capitol Block.
Denver Society of Civil Engineers.—Sept. 8. "Municipal Engineering." Secy., Geo. H. Angell.
American Roadmasters' Association.—Annual Convention, Minneapolis, Sept. 8, 9. Secy., J. P. Ramsey, Muncie, Ind.
Civil Engineers' Association of Kansas.—Sept. 9. Secy., J. C. Herring, Wichita, Kan.
Master Car and Locomotive Painters' Association.—Annual Convention, Sept. 9, Washington, D. C. Secy., Robert McKeon, Kent, O.
New England Railroad Club.—Sept. 9. Rooms, United States Hotel, Boston.
Civil Engineers' Club of Cleveland.—Sept. 11. Secy., A. H. Porter, 50 Euclid Ave.
Northwestern Track and Bridge Association.—Sept. 11. Rooms, Union Station, St. Paul.
Western Railway Club.—Sept. 15. Rooms, Rookery Building, Chicago.
Engineers' Society of Western Pennsylvania.—Sept. 15. Secy., J. H. Harlow, Pittsburg, Pa.
Engineers' Club of Cincinnati.—Sept. 17. Secy., J. F. Wilson.
New York Railroad Club.—Sept. 17. Rooms, Gilsey House.
Scandinavian Engineering Society of Chicago.—Sept. 17. Secy., T. G. Phiffeldt, 113 Adams St.
Montana Society of Civil Engineers.—Sept. 19. Helena.

IN answer to several inquiries we would say that the articles descriptive of methods of car lighting by electricity and by oil lamps will follow the description of the Pintsch gas system in the series of articles on "The Comparative Merits of Various Systems of Car Lighting," now in progress in this journal. We may take this occasion to repeat the request for information, published in several consecutive issues some months ago, for authentic particulars of accidents or casualties resulting in the loss or injury of life or property which have been in any way due to the lamps or appliances of any system of car lighting now in use. The name of the informant and the location of the disaster will be withheld from publication if desired.

THOSE interested in the safe handling of crude petroleum for supplying furnaces, boilers, etc., will find a simple arrangement, which seems to leave little to be desired in the way of safety, illustrated in connection with this week's installment of our series of articles on car-lighting systems. The very convenient method of feeding oil from the storage tanks to burners or to gas retorts by gravity is generally conceded to have too much risk to be advisable. An accident or break in the pipe is liable to leave the oil free to flow to the ruptured point, and make a fire there which cannot be controlled. In the plan illustrated the advantages of the gravity system are largely retained by feeding the oil by gravity from a small supply tank into which the oil from the storage tanks is pumped. The safeguards devised to prevent accidents occurring from this storage tank form quite a novel combination, and one which has proved satisfactory in service.

WE record elsewhere some interesting experiments on the strength and fire-resisting power of several systems of terra-cotta fireproof flooring. The tests showed a great superiority in the arches of porous terra-cotta with the hollows running at right angles to the beam, compared with the arches of hard-burned terra-cotta with cores running parallel to the beam, both in strength and in resistance to fire. The tests were by far the most severe of any ever made, so far as we now recall; and the resistance of the porous terra-cotta was most remarkable. Certainly a flooring which will sustain a concentrated load of 15,500 lbs. on a space of 12 sq. ft., and resist for a dozen times without injury alternate applications of fierce flame and a stream of water, may be accepted as good enough for any position.

IN our issue of June 27 we published some figures giving the mileage life of cast iron wheels in street-car service which showed a very high mileage life, and compared them with the figures given by Mr. HENRY M. HOWE, in his paper on "Manganese Steel," published in our issue of June 20. Mr. HOWE'S figures were gathered from "one of the most important street railways in the country," and showed a mileage life of from 4,500 to 16,000 miles for street car wheels, including some of steel as well as cast-iron.

We criticised these figures as being probably much below the average service obtained from cast-iron wheels on street railways; and we are now able, through the courtesy of officials of three of the most important street railways in the country, to present evidence in support of our statement. The Broadway & Seventh Avenue road in New York City is operated by horses; and while the speed is low, the exceedingly frequent stops and the heavy traffic carried must make the service as severe on wheels as on any horse road in the country. The company has 227 four-wheel cars, and the cast iron wheels used under them have an average life of 48,914 miles.

The Citizens' Traction Co., of Pittsburgh, operates 12½ miles of cable road. The average life of a 22-in. chilled cast iron wheel under the cable cars is 25,000 miles.

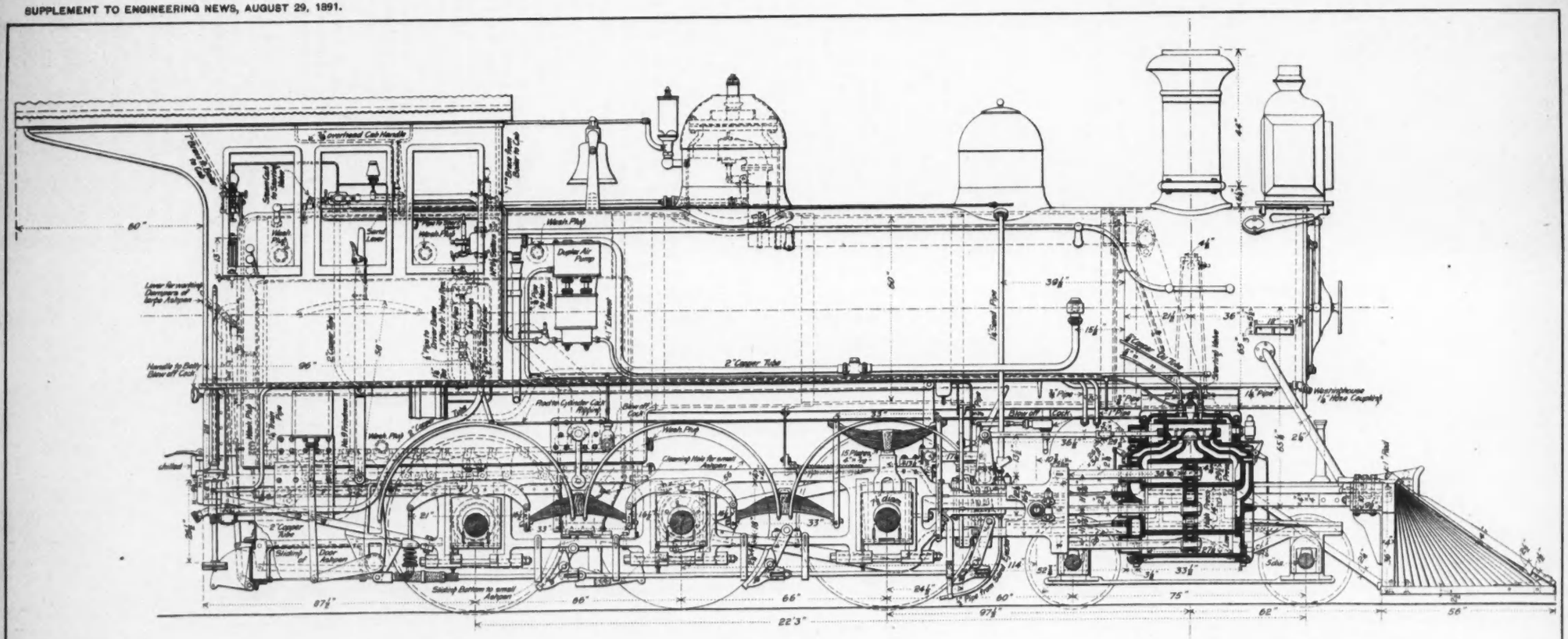
A third company, operating one of the largest systems of street railway in the United States, writes us as follows:

> On cable lines our cars run from 10 to 14½ miles per hour, making frequent stops with a very powerful brake. The chilled wheels under these cars average about 22,000 miles. On the horse lines the mileage is somewhat better, but the work on the various routes varies so materially that figures would be of little value.

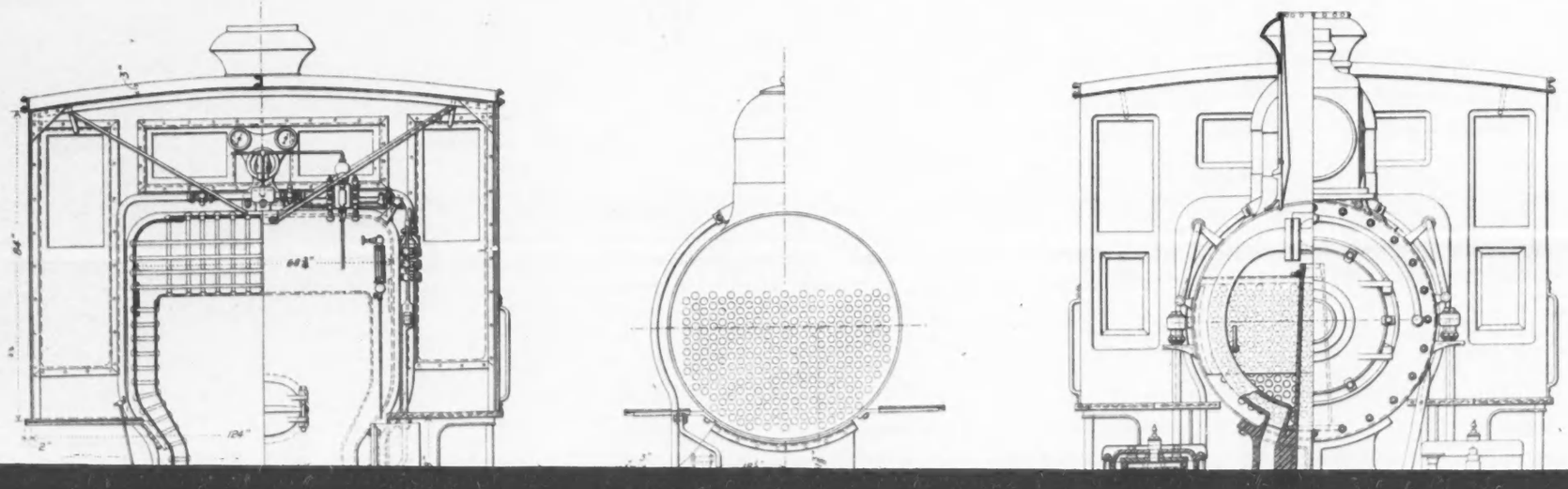
It will be noted that no electric railways are given in the above. It is perhaps possible that the passage of the current from the wheel to the rail may have some effect in reducing the wheel's life; but the above figures seem to be a fair statement of the average mileage life under heavy service on horse and cable railways. It seems altogether probable that the average life on roads of moderate traffic is largely in excess of the above figures.

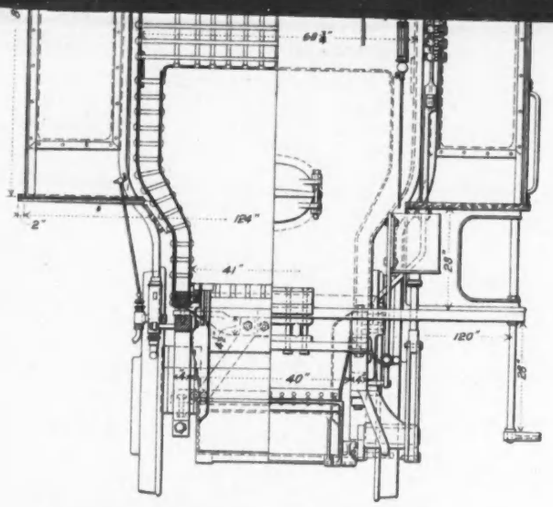
THE horrible disaster in Park Place, in this city, last Saturday, cost the lives of over 60 occupants of a shaky but "inspected" building. The wreck is now about cleared up, and the authorities are trying to fix the responsibility. From all the evidence that we are yet able to gather, there was no explosion of gas or chemicals, as at first reported, and still insisted upon by the building inspectors. Barrels of oil, cans of benzine and other inflammable substances have been found in the wreck; but they are intact, and it is not reasonable to suppose that some of these could have exploded without firing the rest. There is enough evidence of another nature to point to the true cause. The first of these is that widely spread, shallow holes in the walls of the adjoining buildings show that the floor beams proper ran from front to rear of the building, and rested upon a few cross girders that had a very insecure hold in the side walls, and had seemingly nothing but brick under them. On these floors, and transmitting a most dangerous jar in the direction of the floor beams, were fifteen heavy printing presses, located in the fourth and fifth stories of the building. Added to the fifty tons or more of these presses were other tons of paper, printing material and general stock. The walls had already cracked under excessive load, and these cracks were hidden by pasteboards nailed over them, bearing an inscription forbidding them to be torn down. And, lastly, the building was erected 20 years ago for an entirely different purpose, and was admittedly less strong than present building laws would have required for present use.

In fact, the structure has been in a dangerous condition for some time past, and the hand of Providence, and not the care of man for man's security delayed so long the catastrophe of a week ago. With overloaded walls and floors, inefficient support to a few main girders, floor beams resting on a front wall pierced by many openings, and the rhythmical jar of heavy presses ever imparting motion in the direction of least resistance, it needed but little to bring about the catastrophe. The fall of a 600-lb. bale of paper from the top of a pile may have been sufficient under the delicate conditions described. The question now is who is responsible for this loss of innocent life. Some of the occupants must have known that the building was shaky and dangerous, for some one concealed the cracks in the wall, and workmen left the building because "it shook so." It was the duty of the building inspector of that district to see that the floors were not overloaded, and that the construction was sufficient for the uses to which the building was now put. The inspector says he did examine it carefully in every floor, and "found nothing to excite his suspicion"; and in the same breath he says that overloading caused the collapse. He was either utterly inefficient and ignorant of his business, or he was criminally negligent. In either case he should be punished to the full extent that the law can reach him; and the law that permits men to trifle with human life should be at once modified so as to make the appointment of similar inspectors impossible in the future. This was a case where it was seemingly no man's business to compel abandonment or the strengthening of a dangerous structure; and in a city where many other old buildings are daily converted to uses in which heavy machinery is employed, the fact is not encouraging. In similar cases the owner, safe at a distance, does not examine too closely into a



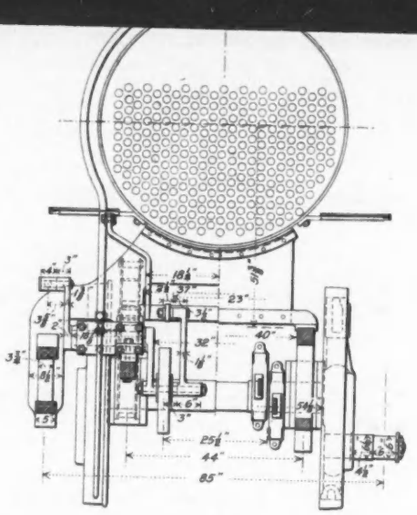
ELEVATION AND PART LONGITUDINAL SECTION.



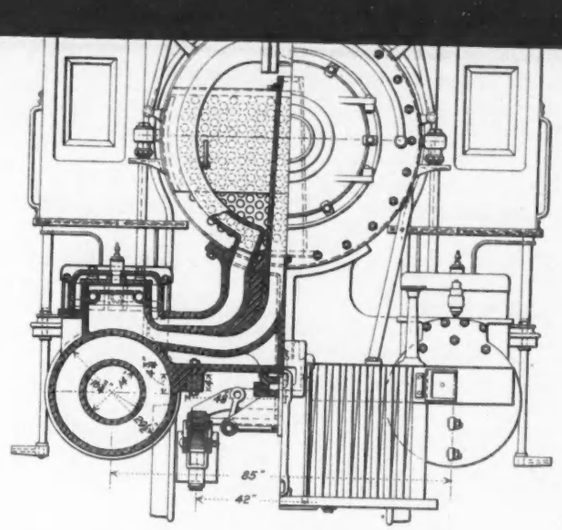


Half Cross Section through Firebox.

Half Rear Elevation.



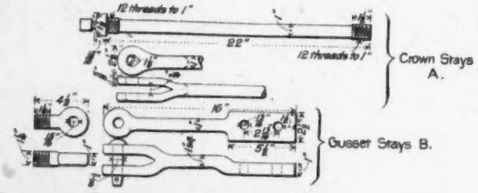
Cross Section
at
Front Drivers. Main Drivers.



Half Cross Section through Cylinders.

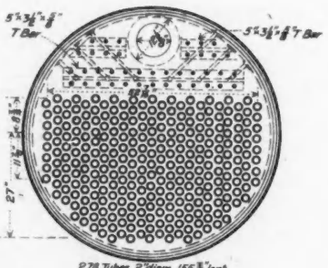
Half Front Elevation.

CROSS SECTIONS AND END ELEVATIONS.

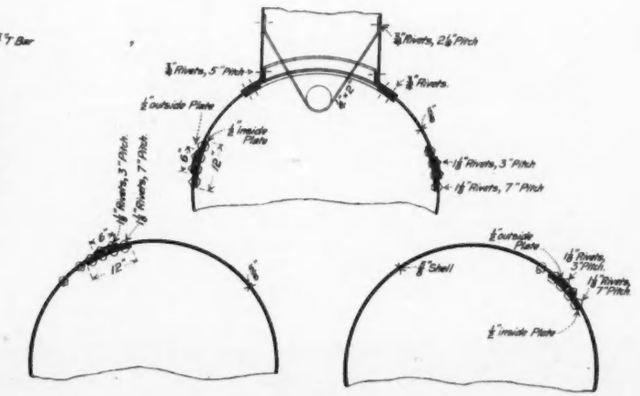


Crown Stays A.

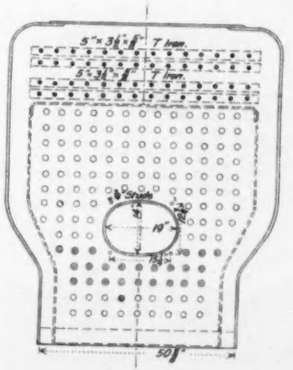
Gusset Stays B.



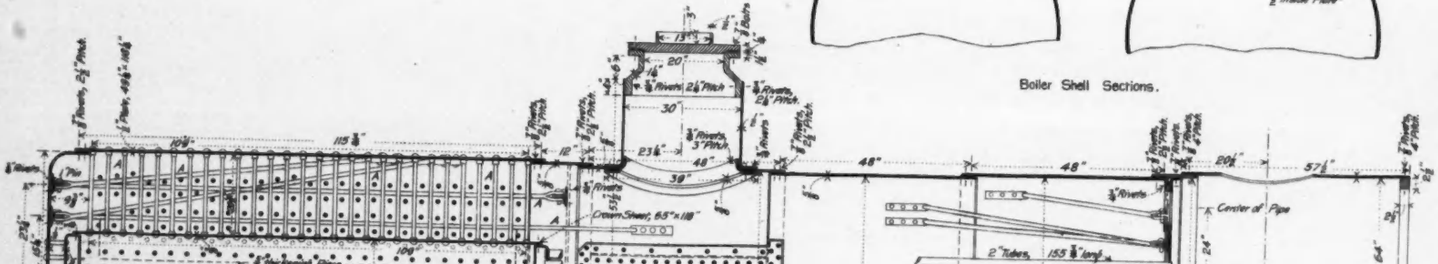
Cross Section at Smokebox Tube Plate.

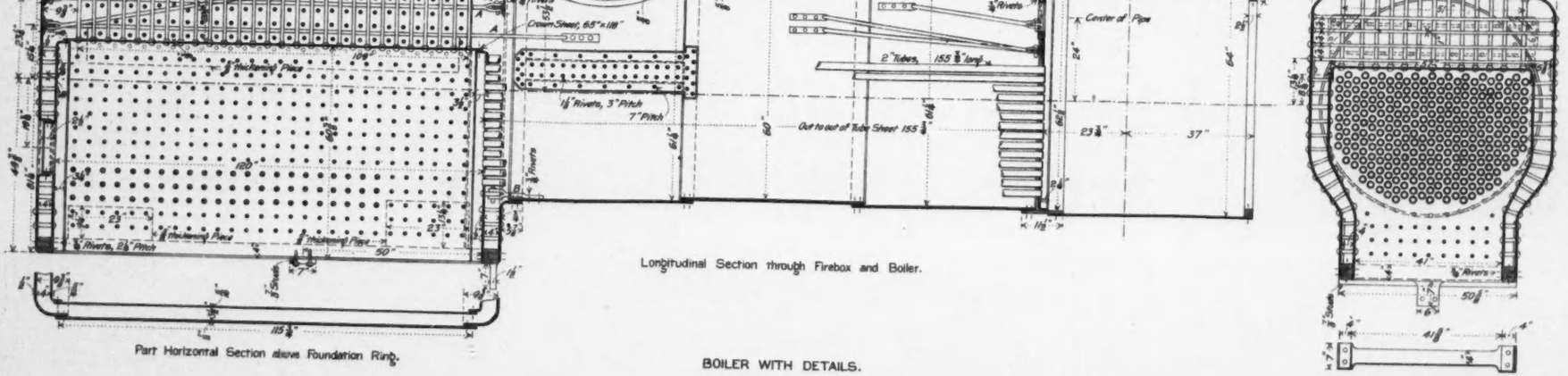


Boiler Shell Sections.



Rear Elevation of Firebox.





Part Horizontal Section above Foundation Ring.

Longitudinal Section through Firebox and Boiler.

Cross Section at Firebox Tube Plate.

BOILER WITH DETAILS.

TEN-WHEEL COMPOUND LOCOMOTIVE; MEXICAN CENTRAL RAILWAY.

F. W. JOHNSTONE, SUPERINTENDENT OF MOTIVE POWER AND MACHINERY.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

state of affairs which may cost him much money; the occupant takes the chances to avoid business annoyance and delay, and with the poor workmen, who are always the majority of the victims, it is a case of "bread and butter." When all is said, it is the building inspectors and the department that appoints them that is most to blame, for they have a plain duty to perform; they are placed in office for a specific purpose and they have all the authority the law can give to enforce their mandates. But if this inspection is entrusted to ignorant, uncertain or careless hands, then the appointing power should be made to feel the responsibility of office as well as to enjoy the emoluments. We trust that the district attorney will push his investigations in whatever direction they may lead, and that the awful warning of Saturday last may compel other inspectors and owners to look more closely after the safety of property elsewhere in this city.

Greenwich the Prime Meridian.

The recommendation, by the Geographical Congress at Berne, that Greenwich be adopted by all nations as the common prime meridian, accords with the action of the International Conference held in Washington in 1884. The world is a unit now, and in the measurement of longitude and the division of time it is essential that all computations should start from a common base line. There is no room for national or sectional jealousy, as in the day when the known world was a very small world and each nation was a law unto itself, in this and in all other things. England, as the chief maritime and commercial power in the world, and with great colonies in both hemispheres, certainly would have the first choice among nations, were the question to be decided by national influence and interest. But when to this fact is coupled the further fact that the United States, the next nation in extent of territory and commercial power, also tacitly accepts Greenwich by giving it in connection with Washington on nearly all her maps, and other nations do the same, the argument in favor of the adoption of Greenwich as the universal prime meridian is overwhelming.

In the far past the choice of a starting point in astronomical observations has been a matter of accident or convenience. HIPPARCHUS, about the middle of the second century B. C., first systematically attempted to classify the stars and to determine their position and magnitude. He marked the position of places on the earth, as he knew it, by circles drawn perpendicular and parallel to the equator, and drew his prime meridian through Rhodes. His disciple, PTOLEMY, pushed his prime to the "Insulæ Fortunæ," the furthest known land to the west; but until our ancestors commenced to start out their ships on voyages of discovery, about the fifteenth century of our era, the exact position of a prime meridian had little importance and excited little controversy.

For awhile the peak of Teneriffe was frequently used as a first meridian, but, owing to the adoption of other meridians, the necessity of some fixed point of departure was first scientifically discussed by a congress assembled by the order of RICHELIEU, in Paris, in 1630. This congress selected the island of Ferro for this purpose, and in 1634, by authorization of LOUIS XIII., this meridian, 20° west of Paris, gradually superseded all others. Later than this time England adopted Greenwich, where FLAMSTEED started the royal observatory in 1675; Spain adopted Madrid, and other nations followed a similar course in locating their prime meridians through the capital city. While the United States has for a long time used a meridian passing through Washington, it also has, as before mentioned, used that of Greenwich in connection with it; and in our latest time computations, where the great breadth of our country makes the adoption of one meridian inconvenient, the four standard meridians, adopted in 1883, reckon from Greenwich. "Eastern, Central, Mountain or Pacific time," in the United States, are exactly five, six, seven or eight hours slower than a Greenwich mean-time clock.

In this era of telegraphic news, when the events of the world are spread before us almost as they occur, standard time is an absolute necessity, not a sentiment or mere convenience as it one time was. All civilized nations recognize this fact, and they will probably put few obstacles in the way of adopting the Greenwich meridian, as proposed. We cannot afford to adopt a new prime meridian, and while that of Washington might be the least calculated to excite jealousy among Continental nations, the Greenwich meridian is so universally used, and the maritime power and influence of England is so generally recognized that it would be folly to reject a scientific base applying to all the world simply because it was English.

The Pollution of the Croton Water Supply of New York City.

The Board of Health of New York City is just now engaged in the commendable work of calling public attention to the contamination of the streams on the Croton water-shed, and the need of more effective measures for the protection of New York's water supply from pollution.

An examination of about one-third the area of the water shed has just been made by two of the Board's chemists, resulting in the discovery of serious pollutions along the streams which supply New York City with drinking water. Without going into details, it may be said that there are numerous cases in which barns, privies, stables, slaughter houses, manure heaps and factories are located upon the edge of running streams, and either discharge foul organic matter directly into them or upon the bank, where the rain washes it directly into the stream. The water in Sodom reservoir, which has now been put in use, and is supplying fifty million gallons per day to the city, is said to be polluted by decaying vegetable matter, due to the fact that the area overflowed was not properly cleared of vegetation before flooding. It is stated that even the sites of barns, stables and outhouses, and the quarters occupied by the laborers while building the Sodom dam, were not cleaned at all before they were overflowed by the filling of the reservoir. Even the present quarters of engineers and contractors on property owned by the city have outhouses so located as to pollute the water supply. Another principal source of contamination is the village of Brewster's, in which are nearly 300 buildings, including a large condensed milk factory. The village is partially supplied with sewers, which drain directly into the stream.

We have alluded to the finding of these sources of contamination by the Health Department as a discovery. It is by no means that, however, for they have twice been officially investigated and reported upon during the past 8 years. In December, 1884, and January, 1885, Mr. ALFRED LUCAS inspected the water-shed for the Health Department of New York City; and in July, August and September, 1888, a thorough inspection and survey was made by Prof. CHAS. C. BROWN, C. E., of Union College, on behalf of the State Board of Health. The results of the latter investigation were published in the Ninth Annual Report of the Board and were sufficient to convince the most skeptical that the dangerous filth in New York's water supply demanded attention.

Mr. LUCAS' report in 1885 showed that adjacent to the streams on the Croton watershed there were 1,879 houses, with privy vaults, and 602 barns and barnyards, in which were kept 9,438 cows, 1,284 horses and 1,501 pigs. The location of these buildings was generally within 50 to 150 ft. of the bank of a stream or lake; but a very few were located 500 ft. or more away, and a large number were either directly over the stream or close on its banks. At the time of this report the total population on the watershed was about 20,000. Mr. LUCAS' inspection was not quite complete, omitting a few localities on the water-shed.

At the time of Prof. BROWN'S survey and inspection in 1888, the population on the water-shed had increased to about 25,000. He found the total number of houses on the water-shed to be 5,056, the number of outbuildings to be 5,612. Of the houses, those which deserved special mention as sources of pollution to the streams numbered 2,843, while the outbuildings whose location was objectionable numbered 3,293. These figures are certainly appalling; for while many cities have far larger populations draining into their water supply, it is to be remembered that the Croton supply flows but a short distance from many of these places of contamination before it is gathered in reservoirs for the city's use; and the total quantity of water in the dry season is little in excess of the city's needs. The present investigation by the New York Board of Health shows that the contamination is no less now, and is probably greater than it was in 1888.

Whether the germs of typhoid fever or similar contagious diseases would be destroyed in flowing from a source of contamination on the watershed down the stream to the storage reservoir, and thence through the aqueduct to the city, is a question whose answer can only be conjectured. Chemical analysis of the water as delivered in New York City shows the presence of nitrites in small quantities. Certainly, compared with the water supply of most large cities, Croton water seems a model of purity; but the investigations of bacteriologists have shown that the appearance of water, or even a chemical analysis, afford little assurance of its safety for drinking purposes. Without doubt it is the opinion of the people of New York that the waste from a population of five to ten thousand people should not be permitted to flow into the city's drinking water; and it remains to find out how this pollution may be effectively and permanently prevented.

While the State of New York deserves some credit for passing a law providing for the sanitary protection of the water-sheds supplying cities with water, it must be confessed that neither the original law nor the law as it stands at present are to be regarded as models. The original law was passed in 1885, at the instance of the city of Rochester, which desired to protect from pollution the waters of Hemlock Lake, from which it derives its supply. This law empowered the State Board of Health to establish rules for the sanitary protection of any water-shed from which a public supply of potable water is taken. The authorities in charge of the water supply of any city for whose benefit rules have been established may inspect the water-shed, to ascertain whether the rules established are obeyed. In case a violation is found, a written notice must be served upon the offender; and if he continues in his violation, his case may be reported to the State Board of Health. This board then examines into the matter; and if it finds that a violation has actually taken place, it must notify the local board of health to convene and enfore the regulation. If the local board does not move within ten days, then at last the municipality or the water company whose supply has been contaminated may bring a suit to recover the amount of the penalty, fixed by the State Board, which in case of the Croton water-shed is limited to from $50 to $100.

Here was certainly circumlocution enough to discourage any attempt to enforce the law. Nevertheless, considerable has been accomplished under it. In the protection of Hemlock Lake, which supplies water to Rochester, the rules established

by the State Board of Health seem to have worked very well. A full description of the system there employed was given in our issue of April 28, 1888. One reason for this is the sparse population on the watershed and the fact that the summer residences along the shores of the lake, pollution from which was among the principal things which it was desired to suppress, are inhabited largely by citizens of Rochester, who are willing to observe the needful sanitary precautions. Another reason is that the removal of garbage and night soil has been taken charge of by the city of Rochester, and is no expense to the residents upon the watershed.

After the inspection of the Croton watershed by Prof. BROWN in 1888, the State Board of Health established a code of rules for the prevention of contamination of New York's water supply. These rules were by no means excessively strict nor onerous; yet from the recent investigations of the City Health Department, it appears that they have been absolutely ignored. The reason for this is as follows: Notwithstanding the tedious and roundabout method which the law provided for enforcing the established rules, something was done in this direction in 1889. The State Board of Health, however, had made no provision for having the city meet the cost of changes which the rules made necessary; and the dwellers on the Croton watershed, who had been all their lives accustomed to discharge waste into the streams, were greatly opposed to moving their buildings and going to the expense of the various sanitary precautions required for the benefit of New York City. They therefore went to the legislature of 1890, and secured the passage of a law which practically nullifies the Board of Health regulations. This law provides in the broadest terms that all changes, removal of buildings, or injury to any person's or firm's property caused by the enforcement of the Board of Health's regulations, must be paid for by the city whose water supply is to be benefited. Of course, any public nuisance is excepted; but in effect this law declares that the dwellers along the tributaries of the Croton have a right to continue their pollution of these streams unless New York City compensates them for the trouble and expense of adopting a different method. As a matter of protection to the rights of the dwellers on this and other watersheds, there was undeniably something to be said in favor of this law; but it has made impossible the protection of the Croton and its tributaries from pollution without further legislation. It is not to be expected that any city will spend the large amount of money required to put a watershed in good sanitary condition unless it is given direct control over the maintenance of these conditions and the right to establish a sanitary policing of the water-shed. To allow a complaint against an offender to make a circuit through two Boards of Health and a civil court before it reaches him, is quite out of the question.

The total area of the Croton watershed is 361.82 square miles. Its population is probably over 25,000, and there are estimated to be over 33,000 domestic animals. There are about 50 manufacturing establishments of different kinds. The purchase and depopulation of this large territory is quite out of the question, nor is it needed; but the whole watershed should be put in such a sanitary condition as the rules established by the State Board of Health contemplated, and the enforcement of sanitary regulations by proper inspection and policing should be in direct charge of a branch of the city's water department. It will doubtless require some hundreds of thousands of dollars to effect this improvement after the necessary legislation is secured; but it must be done sooner or later, and the cost will be greater as the population on the watershed increases.

Nor is the question one which affects New York City alone. There are many cities which years ago went to distant and sparsely populated regions to secure a supply of pure water, and which now find the increase in population along these streams threatening the purity of the supply. General laws on the subject of river pollution are good as far as they go, but they do not go far enough. Nor can rules established for one watershed be applied without injury to every watershed. Each case deserves careful study, and the inauguration of a system of protection suited to the circumstances. And the carrying out of any system should be left with the city whose interests are at stake.

CORRESPONDENCE.

Titles of Engineers.

CEDARTOWN, GA., Aug. 22, 1891.

TO THE EDITOR ENGINEERING NEWS:

SIR: The articles by your various correspondents about engineers' titles are interesting as showing the diversity of custom, but there is still another system that seems to me at least rather unequal.

On the Mexican Southern system the division engineer has charge of a division of from 30 to 50 miles, while the man in charge of 6 to 10 miles is called a sub-division engineer. The term resident is unknown, but there is a general supervising engineer assigned to special duties like Mr. SHUNK's, Principal Assistant, who is styled district engineer, while the man in charge of survey party is called locating engineer. It seems to me that these titles define pretty clearly the duties of each man.

Very truly,
F. C. HAND.

JACKSONVILLE, ILL., Aug. 21, 1891.

"Assistant Engineer," of Dallas, Texas, is mistaken as to the titles of engineers on the Gulf, Colorado & Santa Fé. The assistants to the "Assistant Engineers" are titled "Division Engineers." "Resident Engineers" on the above road are directly under the division superintendents.

Would it not be well to bring the subject of "Titles of Engineers" before the Congress of Engineers to be held in 1893 at Chicago, as nothing very definite can be done before that?

RESIDENT ENGINEER.

Red Lead as a Preventative of Rust on Iron and Steel.

ALTOONA, PA., Aug. 22, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Noting recent discussions on the subject of preservation of iron and steel, I have used red lead quite extensively in practice for over 30 years, and find it is the best material for preserving iron under all circumstances of which I have gained any knowledge. I have found it effectual in painting iron structures of all kinds exposed to the variable temperatures of our climate, also for use in water even where sulphur was present from drainage of mines. Some 30 years ago I was engaged in removing a wire suspension aqueduct over the Allegheny River at Pittsburg, built by the State of Pennsylvania, it being one of the first suspension structures built in this country by JOHN A. ROEBLING, C. E., and when I came to remove the anchors, composed of forged link bars connected by pins and embedded in cement masonry, I found them heavily coated with red lead paint, and on removing the coating the iron was found in a perfect state of preservation, free from any indications of rust. This fact being reported to Mr. ROEBLING, he came and made a personal observation, and was delighted to find such to be the fact, in view of having coated the anchors of the Niagara Suspension Bridge with the same material a few years before.

It is evident from close observation and long practice that no better preservative of iron and steel has yet been discovered, and is not likely to be for a long time to come.

A. J. WHITNEY,
Civil Engineer.

The Laying out of Towns.

MIDDLESBOROUGH, KY., Aug. 19, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: One of the standard daily papers, the *Baltimore Sun*, of Aug. 8, 1891, publishes a communication on "The Size of City Lots," which, in consideration of the extension of the limits of many of our large cities, and the building of so many new towns throughout the country, seems to be worthy of some notice. There are two plans, under one of which most towns are built. First, Those which start with a house or two, and slowly grow to a sufficient population to be incorporated. Second, Those incorporated by a town company, and the population drawn in by manufactories.

In the first class we find the land owned by many people, and as the town grows each may has his land laid out to his best advantage, without regard to a uniform and settled plan. This almost invariably results in streets running at various angles and of many widths, with blocks of many different sizes—it is the plan on which most of our older towns and many of the younger are built. In the second class the land is all owned by a syndicate or town company, who have it plotted and staked out after a definite plan. In this case the engineer in charge has the chance of adopting the best plan the topography of the land will admit of.

What is the best plan? There is only one character of country that will admit of a uniform plan being used, the level or that where the changes in elevation are not beyond the maximum grades to be adopted for the streets to any great extent. As most towns have more or less of this kind of territory, we will consider it.

The width of the streets is governed by the amount of traffic to be passed over them, the value of the land, the character of building to be erected, or the effect aimed at.

Choosing the direction in which the greatest traffic will be, and the position most suitable for the principal street, we would lay off an avenue 100 ft. wide, and parallel to it avenues 70 or 80 ft. wide, as circumstances would best determine; with cross streets 60 or 66 ft. wide.

What shall be the distance of these avenues and streets apart, or in other words, the size of the blocks? Shall we have alleys or not? Looking over the maps of the different cities, we find rectangular blocks of many sizes, without noticing the irregular blocks. New York and Brooklyn have blocks 200 × 400 ft. In some of the newer parts of Boston the blocks are 550 × 100 ft. In Baltimore 320 × 150 ft.

As the size of the lots determines the size of the block, we will consider that. The first object is to get the greatest number of front feet out of a given area without making the lots so small as to make them unsuitable for the use they are intended. Judging from the size of lots in the different cities, the depth needed generally for business property, the most valuable, and also that required for the average dwelling, where it is not necessary to have a stable, is about 100 ft. This would make the blocks 200 ft. wide. But shall there be alleys or not? In New York we find lots 100 ft. deep running back to a division fence. But land in New York is extremely valuable. Hemmed in by the narrow limits of a long island, with people ever crowding for admittance satisfied to put up with discomfort if they can only get a place to live, it hardly offers a suitable example for other less crowded places. In the newer parts of Boston and most other cities we find alleys more plentiful than in the older sections of these cities, which shows they have come to feel the need of them. Why should they need them? Pass along the streets that have no alleys in the rear of the houses, and what do we see? The front pavement decorated with every conceivable kind of receptacle, empty or filled with garbage and ashes, which every puff of wind whisks over the pavements and in the doors and windows of the houses and the eyes of the passing pedestrian.

Then the sewerage system not being complete, which is about the case in every town, the O. E. A. man has to be called in. How is he going to get back with a solid brick wall running from street corner to street corner, the only openings on the street being the front doors and windows? Through one or the other of these he must go with his not overly-clean pipe. In the town from which I write, Middlesborough, Ky., we feel the want of alleys in the blocks even at this early date.

With the separate system of sewerage, what a fine place to lay the pipes where they are needed, in the rear of the buildings, away from the water mains, and doing away with those ever-undesirable sewer connections through cellars, always liable to leak sewer gas if nothing more. Telegraph poles can also be placed there, removing them from the main streets, and the wires would be less in the way of firemen. To get the best results out of an alley it should be from 12 to 20 ft. wide, the greater width if practicable. This would make the blocks from 212 to 220 ft. wide from avenue to avenue.

There is one objection to the alley plan that is often brought forward: that people with deep lots, say 150 ft., finding that they have more land than they need for their private use, build a house in the rear of the lot, fronting the alley. In Philadelphia we find an ordinance against fronting houses on alleys less than 30 ft. wide. But this is due to the depth of the lot, not simply because the alley is there. The narrower the lots the more need of alleys. In residence property, with lots of 50 or more feet front, there is room for a road to the rear; but even there the convenience of alleys is felt.

The width of the blocks being fixed, what shall be their length? The location and amount of travel will best determine this. Four hundred feet seems to be a good length.

Shall the wide or narrower streets run with the length of the blocks? We find both conditions to exist.

Houses fronting on the broader streets have more air and light. The streets themselves have a better appearance. Here people and teams use the streets on which

the houses front rather than the side streets. There is one condition that might be considered where it would be an advantage to have the wider streets at the side of the houses: The street car tracks could be placed on them, giving more room to passing teams and relieving the fronts of the houses of the noise and dust, but they would not be so convenient to the people. This is hardly sufficient to outbalance the other conditions.

To sum up, we would have the blocks 220 × 400 ft., with alleys 20 ft., bounded by avenues 70 to 80 ft. on the long sides and streets 60 to 66 ft. on the short sides.

Yours truly, W. H. DORSEY.
Asst. Engr. M. T. Co.

The Moran Flexible Joint for Steam Pipe Connections.

Among the exhibits at the Master Mechanics' and Master Car Builders' Convention at Cape May last June was a flexible steam pipe joint, which from the severe test to which it was subjected attracted much attention. The joint is an all-metal one of the ball and socket type, and those in charge of the exhibit claimed that the joint would keep steam tight, no matter how much it was exposed to dust or foreign matter. As one of the listeners seemed rather incredulous on this point, they proved the truth of their assertion by turning off the steam and throwing handfuls of sharp sand from the road into the interior of the socket, also wedging in wisps of hay, horse hair and other fibrous substances. In every case, as soon as steam was turned on and the joint was moved about, the foreign substances were

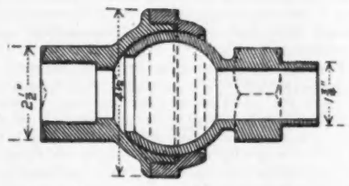


Fig. 1. Section of Moran Flexible Steam Joint.

cleared out from between the bearing surfaces and leakage ceased in a few seconds.

The main features of this joint are the spherical bearing surfaces of cast iron, which are carefully turned and then ground to a close fit. Under constant motion the wearing surfaces of the ball and the socket in which it moves take on a mirror-like polish, and it is claimed that the surface thus formed is so hard as to offer great resistance to abrasion.

Fig. 1 is a sectional view of the Moran joint. The details of construction are varied of course, according to the special uses to which the joint is to be put. One of the principal users of these joints is the Standard Oil Co. Rubber hose is of course unsuited for handling petroleum or its products, on account of the action of the oil upon the rubber; but this all-metal flexible connection has supplied the place of hose very well. A barrel filler, made with the Moran joint has been in use for a number of years by the Standard Oil Co., and Mr. GEO. H. HOPPER, General Manager of the Barrel Preparing Department, states that he is entirely satisfied with its efficiency. The shipping and lighterage department of the company have also had large sizes of the joint in use (generally 6 in.) for loading and unloading bulk steamers, and consider them superior to hose.

For steam pipes the joint has been largely used to furnish a metallic connection for rock drills. While somewhat more expensive than hose, it presents the advantage of far greater durability and less stoppage for repairs.

Another place where the joint has given great satisfaction is for the steam connection from the locomotive boiler back to the baggage car on trains using electric light. In the system in use on the limited trains between New York and Cincinnati over the Chesapeake & Ohio, the steam is taken at full boiler pressure from the locomotive and is carried to an engine running the dynamo placed in the forward end of the baggage car. Carrying the large amount of high pressure steam which this engine requires is a very different matter from transmitting the smaller amount of steam at low pressure used for car heating; and much trouble was experienced in securing suitable hose to withstand the heat and strain of the high pressure steam. Last December a trial was made of a pipe connection with Moran joints in place of the hose, and it has been in use ever since on all four of the "F. F. V." limited trains, giving excellent satisfaction.

The Moran joint has also been used to make the connection between the cars in steam car heating systems. The apparatus is shown in perspective in Fig. 2. Four of the flexible ball joints are used, and the coupling at the center of the straight connecting pipe is made without rotation of the

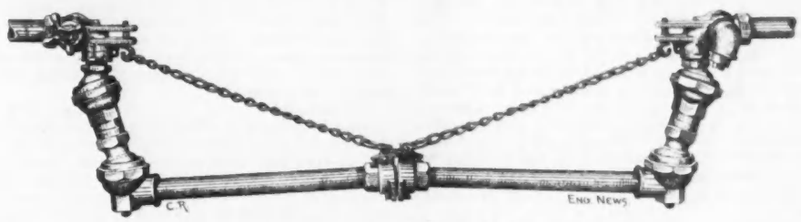


Fig. 2. All-Metal Connection for Steam Car Heating Systems.

coupling faces upon each other. The apparatus illustrated was used last winter for all the connections between cars on the steam heated "Florida special" trains from New York City to St. Augustine. The makers state that these connections finished the season without repairs or renewals of any kind. It should be said that in Fig. 2 the apparatus is shown in the position it assumes when just on the point of pulling apart by the separation of the cars. The uncoupling, both automatically in the position shown and by hand, is performed by the chains, which when drawn taut lift the top hooks which hold the two parts of the coupling together. In practice a second chain is used, running from the horizontal pipe to the car platform above, and preventing the pipe from hanging too low when the cars are uncoupled.

In making the Moran steam joint the rear part of the hemispherical socket is made of slightly greater radius than the ball, instead of being ground to fit it. The result is that when steam is off the ball is free to move slightly inward in the socket. This opens a narrow space between the bearing surfaces and permits any condensed water to run out. When pressure is applied the ball instantly seats itself against the front of the socket, making a steam-tight joint. It is claimed that this is one reason why the joint resists so well the action of grit. The bearing surfaces being only held together by the yielding steam pressure, any grit interposed between their faces is free to separate them, and can work out without embedding itself in these surfaces.

Fig. 3 shows a combined joint and trap used where a considerable amount of condensed water is to be disposed of. It consists in the addition of a burnished steel ball seating in a valve metal case and held up from its seat when steam pressure is off by a bronze spring.

Any further information concerning this joint may be obtained from the Moran Flexible Steam Joint Co., 149 Third street, Louisville, Ky.

Specifications for Sewers, Boston, Mass.

The following is an abstract of specifications for Section 2 of the Metropolitan Sewerage System, being the main and outfall sewer on Deer Island. The specifications for most of the work being carried out by the Board of Metropolitan Sewerage Commissioners are very similar to those given. They are very full and complete, and give considerable power and authority to the engineer, requiring all work to be done to his satisfaction.

EXCAVATION.

All surfacing material that covers the location of the trench, including pavements, paving gravel, road metal, etc., shall be removed for a suitable distance in advance of the deep trench, and kept separate as may be directed, to be again used in repaving or resurfacing the street, road or ground.

The sewer grade referred to in the specifications is as follows: Where a timber foundation is used, it is the under side of the ribs, or sills, or pile caps. Where no timber foundation is used, it is the under side of the masonry or concrete. When the sewer is built in compressible material, the width of the trench shall be sufficient, if required by the engineer, to leave 18 ins. clear between the masonry of the sewer and the sheeting of the trench. The bottom of the trench is, in general, to be excavated to the exact form and size of the lower portion of the sewer which is to be laid in it. In case of pipe sewers, the bottom of the trench shall be trimmed to the form of the outside of the pipes, with additional excavation at the joints, so that the bearing shall be continuous and the pressure equally distributed.

Only such ledge or rock as, in the opinion of the engineer, requires blasting for its removal, and bowlders of ½ cu. yd. or more in volume, which are removed from the trench, will be estimated as rock excavation. In rock the width of the trench shall be fixed by the engineer as the work progresses, and no payment will be made for rock excavated outside of the specified limits. In general, rock will be measured from its surface to a depth of 6 ins. below sewer grade, and with an estimated width of 1 ft. greater than the outside width of the sewer.

Blasts are to be covered with heavy timber chained together; caps or other exploders shall in no case be kept in the same place in which dynamite or other explosives are stored. The contractor is to furnish sufficient pumping plant, and is to provide and maintain drainage in the trench satisfactory to the engineer. Water is not to be allowed to rise on any masonry until the mortar has set to the satisfaction of the engineer, and no stream of water shall be allowed to flow over masonry until such time as the engineer may direct.

FILLING.

All excavations below sewer grade shall be refilled with gravel, in thin layers, thoroughly wet and rammed, or, if directed by the engineer, the filling shall be made of con-

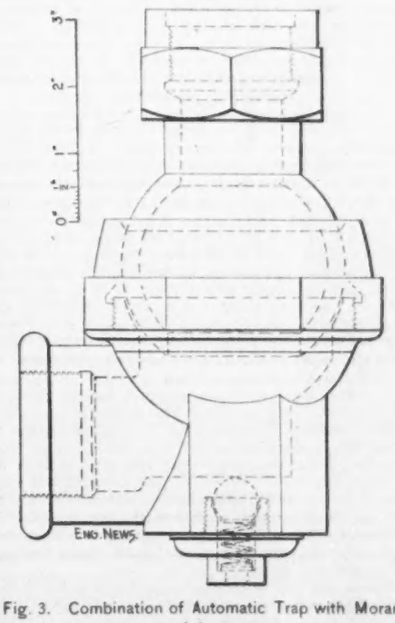


Fig. 3. Combination of Automatic Trap with Moran Joint.

crete or rubble masonry. The spaces between the piles and between pile caps or sills are to be refilled with suitable material to the height of the under side of the timber platform. When a "cradle" foundation is used, the back-filling up to the springing line of the sewer shall be made with satisfactory material filled in thin layers, thoroughly wetted and rammed. The back-filling to the springing line of the sewer shall be done before the arch is turned, and the bracing inside the sewer shall be left in place until its removal is directed by the engineer.

That portion of the sheeting extending below the crown of the arch of the sewer must be withdrawn, unless other-

wise directed by the engineer, before more than 6 ins. of earth is placed on the arch, and before the center is struck. As the trench is refilled, the sheeting, etc., shall be removed in such manner as to avoid the caving in of the trench. The vacancies left by the sheeting shall be carefully refilled by ramming with tools specially adapted to that purpose, by watering, or otherwise, as may be directed. When the engineer decides that the sheeting or shoring cannot be removed without injury to the work, it shall be left in place, and the contractor shall be paid for the lumber at the rate of $13 per 1,000 ft. B. M.

The trench and other excavations shall be refilled with such of the excavated material and in such order as may be from time to time directed by the engineer. The back-filling must be brought up evenly on both sides of the sewer, so that no unbalanced pressure can be thrown upon the masonry; shall be spread in layers, not exceeding 6 ins. in thickness, which shall be well watered and thoroughly rammed; or where an abundance of water can be obtained, and the engineer so directs, it shall be thrown into the trench and allowed to settle into place through a suitable depth of water. Where the sewer is built with sidewalls they shall be braced, if so required, and the work of back-filling shall be so conducted as not to disturb the masonry. No refilling shall be made with frozen earth.

The surface of the ground in streets and elsewhere shall in all cases be left in as good condition as it was previous to the commencement of the work; and when of gravel or broken stone, it shall be well rolled with a heavy roller; the whole work of refilling and resurfacing to be done in a manner to prevent, as far as possible, after-settlement. The contractor shall keep the street surface over and along the trench and other excavations in a safe and satisfactory condition for a period of six months after the work contemplated in this contract is finished, and shall be responsible for any accident that may occur on account of the defective condition of such surface. All fences and other structures in the vicinity of the work shall be protected, and, if injured, shall be repaired or replaced. All trees in the vicinity shall be protected.

MATERIALS AND WORKMANSHIP.

Cement.—American natural hydraulic cement and Portland cement are to be used in the work. The American-cement must be equal in quality to the best of the Rosendale cements; it must be fresh and very fine ground and put up in well-made casks. The Portland cement must be of the best quality, ground extremely fine, and of good weight, and packed in well-made casks. If required by the engineer, Alsen's Portland cement shall be used.

The contractor shall at all times keep in store at some convenient point in Boston, or within a mile of the work herein contracted for, a sufficient quantity of cement to allow ample time for the tests to be made without delay to the work of construction. The engineer shall be notified at once of each delivery of cement. It shall be stored in tight buildings, and each cask must be raised several inches above the ground by blocking or otherwise.

Mortar.—All mortar shall be prepared from cement in perfect condition and sand furnished by the board. These ingredients shall be thoroughly mixed dry, and, unless otherwise directed by the engineer, in the following proportions: For Portland cement mortar, one part, by measure, of cement, to two parts of sand; for American-cement mortar, used in the brick masonry, one part, by measure, of cement, to one and one-half parts of sand; for American-cement mortar, used in the rubble masonry and in concrete, one part, by measure, of cement, to two parts of sand; and a moderate dose of water is to be afterward added to produce a paste of a proper consistency, the whole to be thoroughly worked with hoes or other tools. The mortar shall be freshly mixed, for the work in hand, in proper boxes made for the purpose; no mortar shall be used that has become hard or set.

Concrete Masonry.—Concrete shall be composed of clean, screened gravel, mixed with mortar of the quality above described. The gravel shall consist of pebbles or fragments of stone of various sizes, no pebble or fragment to be more than 2½ ins. nor less than ¼ in. in its greatest diameter. The gravel shall be mixed with mortar, of the quality above specified, in such proportion that the resultant mixture shall contain one measure of cement, two of sand, and not exceeding five of gravel, and such that the void spaces in the gravel shall be fully filled with mortar.

The mixing shall be done in proper boxes, and after the materials are wet the work must proceed rapidly until the concrete is in place and is so thoroughly rammed that water flushes to its surface and all the interstices between the stones are entirely filled with mortar. Should voids be discovered when the forms are taken down the defective work is to be removed and the space refilled with suitable materials. It shall be allowed to set for a sufficient time before working upon it will be allowed. Where forms are required to hold the concrete in place they shall be set true to the lines, and shall be firmly secured, so that they will not get out of place while the concrete is being laid.

Brick Masonry.—The bricks shall be of the best quality, burned hard entirely through, regular and uniform in shape and size, and of compact texture and with a crushing strength of not less than 5,000 lbs. per sq. in. Bricks which, after being thoroughly dried and then immersed in water for 24 hours, absorb more than 16% in volume of water will be rejected. The hardest and most regular-shaped bricks are to be used on the invert of the sewer. Hard-burned bricks, less perfect than those required for the interior of the sewer, and a small proportion of "bats," all satisfactory to the engineer, may be used on the outer ring of the sewer.

All brick masonry shall be laid with the quality of bricks and mortar above specified, and be of the best quality. The bricks shall be laid to a line, with the beds in the line of the radii of the curves, and with as close joints (not exceeding ¼ in. for facework) as may be from time to time directed. The bricks to be thoroughly wet just before laying. Every brick to be completely imbedded in mortar at its bottom, side and end, at one operation. Care shall be taken to have the interior surfaces smooth and regular.

All unfinished work must be "racked back" or "toothed," as directed; and when new work is joined to its faces, the bricks must be scraped, thoroughly cleaned by scrubbing with a stiff brush, and well moistened.

Rubble-Stone Masonry.—Rubble-stone masonry shall be made with stone of compact texture, free from loose seams and other defects, laid on its natural bed, and of suitable size and shape for the work in hand.

Care shall be taken to have the beds and joints full of mortar, and no grouting or filling of joints after the stones are in place will be allowed. The stones used shall present a good bed for materials of this class, and their size shall vary according to the part of the work where they are to be used. For the side walls of the sewer the stones must have not less than one superficial foot of bed, except the spawls necessary to fill up the interstices. The work must be thoroughly bonded. The headers must be in all cases of sufficient size to secure a strong bond with the rest of the masonry. No spawling under a stone after it is laid will be allowed.

Masonry.—When work is done during freezing weather, the contractor shall provide the necessary means for, and shall heat the bricks, gravel, sand and water, and shall comply with all requirements of the engineer to thoroughly protect the masonry from damage by frost during and after laying; all at the cost and expense of the contractor. No work shall be done on masonry during such days as, in the opinion of the engineer, good work cannot be done. All unfinished masonry shall be properly protected during inclement weather from injury from water or frost. The word "masonry" is understood to include concrete in place; also, the terms "concrete" and "concrete masonry" are understood to mean one and the same thing.

TIMBER WORK.

Piles.—The piles shall be straight, sound spruce sticks, free from defects, not less than 6 ins. in diameter at their lower ends, and of sufficient length to drive well into the hard bottom. Those driven 20 ft. or more shall be not less than 10 ins. in diameter at the point where they are cut off for capping. Of those driven to a less depth, a certain proportion may have a diameter not less than 8 ins. at said point. Any pile broken while driving, or driven off of line, must be replaced at the contractor's expense.

The piles are to be driven in bents, and are to be cut off at the grade given by the engineer; the top of each pile to be exactly level after being cut off, so that the caps which rest on them will have a firm and even bearing.

Spruce Lumber.—Spruce lumber will be used in the construction of wooden platforms for the foundation of sewer, for pile caps, cradling or other purposes. All lumber intended for permanent use shall be sound, straight grained and free from all shakes, loose knots and other defects that may impair its strength and durability. The caps are to be securely fastened to the piles by wrought-iron driftbolts 16 ins. long and ¾ in. diameter.

BRICK SEWER.

The general sections of the sewer are to be made to conform to the drawings furnished and directions given from time to time by the engineer, and are to be built of brick masonry, concrete and rubble-stone masonry. The foundation may be of earth, concrete or other masonry, or timber, according to local conditions. The contractor shall, when required, construct a timber foundation for the sewer and its appurtenances. If a pile foundation is used, it will be constructed in accordance with the engineer's plans and directions. If a platform is used, it will consist of sills, laid either transversely or longitudinally, and a flooring of planks or boards spiked to each sill with suitable spikes.

If a cradle is used it will consist of ribs laid transversely and a single or double lining of boards secured to each sill with suitable nails. Where required paper shall be used between the double layers of boards. The planks and boards used in the floor and lining shall be straight edged and laid to make as water-tight work as practicable. The paper will be furnished by the board; but the expense of putting it in place is to be included in the price for spruce lumber in place and secured. If the foundation is of concrete it shall be of such form and dimensions as the engineer may require.

Where required by the engineer drainage shall be effected by a drain pipe laid below the sewer. The drain pipe shall be vitrified sewer pipe, equal in quality to the best Akron pipe. The pipe must be satisfactory in shape and free from cracks and flaws. The pipe shall be carefully bedded, and the joints must be made tight enough to prevent gravel and sand from passing through them; if necessary the joints shall be wound with thin cloth furnished by the board. The refilling about the pipe shall be solidly made, as directed. The whole cost of the pipe, excavation, laying, winding and refilling around it is to included in the price for under-drain pipe laid and secured.

Water-tight work is aimed at; and to this end, in addition to the general good quality of work required, the whole interior face of the rubble or concrete backing, against which the brick lining rests, shall be thoroughly plastered, before the lining is laid, with hydraulic-cement mortar of the kind to be used in building the invert of the sewer. The cost of this plastering is to be included in the price for the rubble or concrete masonry of which the backing is composed. When required, paper shall be used about the masonry; it will be furnished by the board, and the cost of putting it in place is to be included in the price for the brick or concrete masonry.

The contractor shall provide and use, if required by the engineer, 200 running feet of straight centering for the upper arch at each working division of this section. These centers shall be so made, in parts or otherwise, that the rear ones can be struck, carried forward under those in place and set up again as fast as the archwork of the sewer is built.

The inside joints of the invert and of the sidewalls shall be neatly pointed. The inside face of the upper arch, after the center has been withdrawn, shall have all the mortar projecting beyond the surface of the bricks scraped off within three days after the center has been struck, and shall be pointed and left in a neat condition. The extrados of the upper brick arch, from springing line to springing line, shall be plastered with a ¾-in. coating of hydraulic mortar.

Side entrances, bell mouths, reducers, culverts, gate chambers, ventilators, connecting sewers, manholes, lampholes, etc., shall be constructed at such points as may be designated, and according to plans and directions given. Wherever the surface is unpaved, either in roads or in private lands, the iron frames of the covers of manholes, lampholes, ventilators and other structures that reach the surface shall be surrounded with a ring of cobble stone paving extending at least 2 ft. from the edge of the iron frame.

The Recent Water-Works of France.

By a decree of Sept. 30, 1884, there was organized a Consulting Committee on the Public Health of France, and among the important duties of this committee was the examination of the public water supply. A circular was sent out, on Oct. 29, 1884, to the various prefects of departments asking them to submit to the committee all plans for furnishing potable water and a general report of the committee now contains a résumé of the work done in the years 1884-1890.

In the six years covered by the report the committee has examined 333 projects and 341 reports upon them. Of these projects 17 were condemned by the committee, and among these were the proposed water supply for Reims and the leading of the waters of the Yonne to Paris. Of the 316 remaining plans, 3 were not fully reported upon, 15 have been at least temporarily abandoned, 31 have not yet been commenced, 60 are in process of execution, and 207 have been finished. Of the completed works 26 exceeded in cost $20,000, and the total expended on these 26 was $2,053,489, for the supply of 376,412 inhabitants. The remaining 181 works were of a minor character and cost in total $595,512, for a combined population of 205,089. This is an average of $3,290 per project for an average of 1,133 persons to a commune. Some of these works must have been of an exceedingly simple nature, as we find the following expenditures noted: Drôme, $115 for 644 inhabitants; Poët-Laval, $93.20 for 902 inhabitants; Puy-Saint-Martin, $100.60 for 781 inhabitants, and Roche-Sur le Bois, $40 for 520 inhabitants. But as the committee remarks, unimportant as they were in money, each piece of work noted resulted in securing better water and had a corresponding effect upon the health of the users. In many cases, the addition of a short length of pipe to a distribution system already existing cost little money but added materially to the sanitary conditions.

The report goes on to state that these projects were scattered over 57 departments, and there are 30 departments that in these six years have done nothing in the way of presenting plans to the com-

mittee for new or improved water supply. It is too soon to study in any comprehensive manner the effect of the work done upon the public health. But comparisons have been made for 25 communes where the works have been finished for two years. Unhappily, the declaration of the cause of death is not obligatory in France, and in 17 of these communes it was impossible to find what had been the record for typhoid fevers in preceding years. The report treats in detail the several communes where some definite information was possible, and finds that in 23 of the 25 communes, though the death rate has increased in some and diminished in others since the introduction or improvement of the water supply, there are practically no deaths due to typhoid fever.

These results, though not conclusive, accord with the previous experience in the larger cities of France where pure water had been substituted for a bad supply.

At Bordeaux, for example, where the water of the Budos was generally introduced in 1888, the mortality rate for typhoid diseases was, in the years 1886-87, 7 per 10,000 inhabitants. For the two years 1889-90 the average has been 4 per 10,000. At Rennes, where the water supply was of bad quality until 1883, the average mortality from the above cause was 13 per 10,000 inhabitants from 1870 to 1882. For the period 1883-88 it was 7 per 10,000. From 1875 to 1882 the deaths from typhoid fevers averaged 43 per 10,000 among the resident soldiers; this average fell to 2 per 10,000 during the period 1883-89. In Amiens, until 1881, there was an epidemic of typhoid character, notably in the garrison. From 1872 to 1875 the average was 36 per 10,000; and from 1876 to 1880 it was 111 per 10,000. In 1881, the water from the contaminated spring of the Marie-Cañon was condemned and replaced by pure water from Pont-de-Metz. As a consequence, in 1881-1889, the typhic mortality in the garrison fell from 36 and 111 per 10,000 to 7 per 10,000. Among citizens this mortality for the period 1886-90 was on the average only 3.9 per 10,000. In Saint-Etienne, which was fed by water from wells and from the Furens, before 1886, the deaths from typhoid are said to have numbered as high as 400 and even 600 per year, as shown by the statistics at the town hall. In 1886 water was led to the town from a pure source, and the average of deaths from typhic diseases has fallen to 44 per year, in a population of 117,844, or about 3.8 per 10,000 inhabitants.

A Few Practical Uses of the Logarithmic Curve.

BY WM. COX.

The discovery of the remarkable properties of a series of numbers in arithmetical progression, combined with another series in geometrical progression, has contributed very materially to the advancement of science, and that not only from a theoretical point of view, but also in a practical manner. Their embodiment in tables of logarithms has lightened the tedious labor of abstruse calculations, and their adaptation to instruments of different kinds has rendered the solution of both simple and complicated formulas so easy that what is without their aid an irksome task often becomes with their help a pleasure. The most ingenious and undoubtedly the most useful of these instruments is the slide rule, with which the most difficult problems may be promptly and accurately solved. In this instrument a number of *equal* spaces represent the series of numbers in arithmetical progression, while to each one is assigned the value of a series of numbers in geometric progression, each term of series increasing by the same given *ratio*, so that all the computations which are effected by the aid of logarithms can be performed with the slide rule, especially with that latest form, the Mannheim, with which *any* root or power may be easily ascertained.

A variety of calculations may be also very easily worked out graphically by means of a logarithmic curve, thus:

Take a sheet of drawing paper, and on the straight line *A B*, with center *C* and radius *A D* (about 6 ins. long), describe the circle *D E F K*. Then take a true logarithmic spiral curve in cardboard or black rubber, as represented by the shaded portion of the figure, and pass a fine needle through its center, and also through *C*, so that the curve may revolve freely on its axis. The circle, if divided into 100 *equal* parts, would represent 100 terms of a series of numbers in arithmetical progression, each term advancing by the same given rate of difference of 3.6.

If we draw radii from the center *C* to these points and measure off upon them a series of lengths, each one of which shall be greater than the preceding one by the *same given ratio* (such as 1 to 1.01), then these lengths measured upon the radii will determine the points of intersection of the logarithmic curve, and these continually increasing radii will form a series of numbers in geometric progression, the corresponding numbers of which on the circle or any other ratios whose solution may be frequently required.

Whatever may be the position of the curve, the lengths of any two radii from the center *C* to the line of the curve will always bear the same ratio to each other, *provided that the angle inclosed by the two given radii be the same.* If we have only 3 radii inclosing 2 equal angles, then the middle radius is a mean proportional between the two outer radii as

$$a : b :: b : c,$$

and if we have two pairs of radii, each pair inclos-

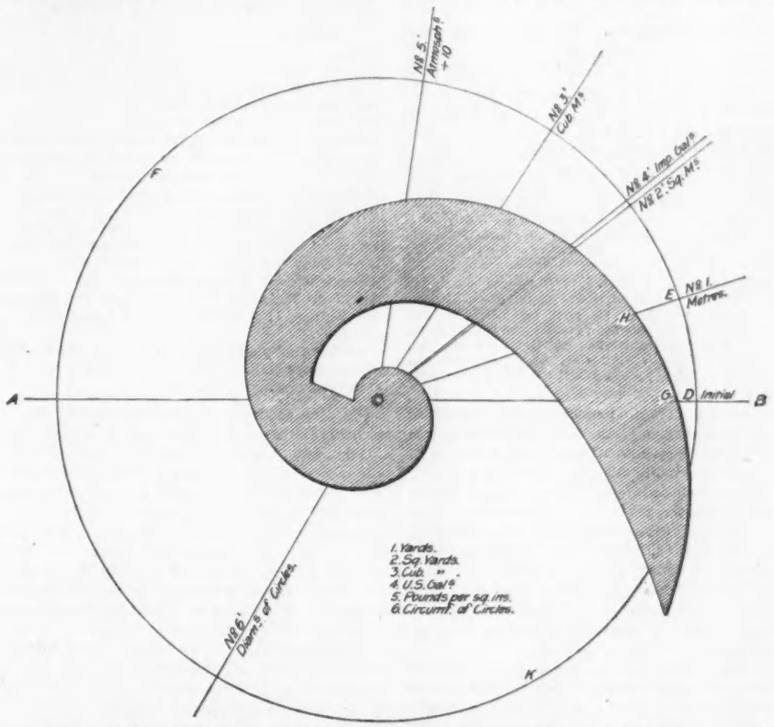


DIAGRAM SHOWING METHOD OF USING LOGARITHMIC CURVE.

will be their logarithms, by means of which we can, as with the slide rule, obtain an endless variety of ratios, and perform a great number of calculations.

Let us, for instance, turn the curve round until a line measured from *C* along the initial line *A B* to the edge of the curve *G* indicates, say, 123 mm.; then holding the curve in the same position, pass our scale round until we reach *H*, so that *C H* may measure 112½ mm. Prolonging this, line we mark the point of intersection *E* on the circle *D E F K*, and thus obtain on the curve with the two radii *C G* and *C H* a fixed ratio of 123 : 112½. To whatever position we now turn the curve round, if we measure along the radii *C D* and *C E* from the center *C* to the edge of the curve, where it is cut by these radii, we shall always obtain two numbers having to each other this same ratio of 123 : 112½. Thus if we place our scale of millimetres on the initial line and then turn the curve round until *C G* shall measure 80 mm., then holding the curve fixed, measure *C H*, we shall obtain 73 mm., so that we have:

$$80 : 73 :: 123 : 112\tfrac{1}{2}.$$

Now this ratio of 123 : 112½ is that which a yard bears to a metre. We therefore mark on the initial line, *No. 1, Yards*, and on the radius *C E*, *No. 1, Metres*, and we have consequently with the last setting of the curve 73 m. as the equivalent of 80 yds.; and similarly we obtain for any other number of yards its eqivalent in metres, or vice versa.

We can now in the same way mark on the initial line *A B*, and on the corresponding points of the circle, such ratios as:

Initial line.		*Radii of curve.*	
No. 2.	Square yard,	and No. 2'.	Square metres.
" 3.	Cubic yards,	" " 3'.	Cubic metres.
" 4.	U. S. gallons,	" " 4'.	Imp. gallons.
" 5.	Pounds pressure per sq. inch.	" " 5'.	Atmospheres (divided by 10).
" 6.	Circumferences of circles,	" " 6'.	Diameters of circles.

Other uses of this curve will easily suggest themselves, one important one being the facility with which the average pressure of steam in an engine cylinder, with any cut-off, may be calculated. The center of curvature of a part of any curve, or the center of any circle, may be also easily ascertained by its means.

It is necessary, in order to be able to take advantage of the various and remarkable properties of the

ing a similar angle, we obtain two ratios or a proportion, as

$$a : b :: c : d.$$

As multiplication and division are also but different forms of proportion, and can be reduced to

$$1 : a :: b : x, \text{ and } a : b :: 1 : x,$$

we can therefore with the logarithmic curve work out graphically sums in these rules, by taking one radius to be equal to 1, 10, 100, etc., according to the scale adopted.

A very simple method of ascertaining equivalent values to the two terms of a ratio, is to cut a piece of cardboard in the form of a sector so that the angle inclosed by the two radii shall be like angle *D C E*, that of the given ratio; then if on a sheet of drawing paper a logarithmic curve be traced and a needle be passed through the center of the sector and also through that of the curve, the two radii of the sector, to whatever position it be turned round, will always give, from *C* to the point of intersection of the radii with the curve, two numbers which will bear the same ratio to each other as that existing between the two radii of the sector. Such sectors, which can be very easily made, then represent the first and second terms of a proportion, and if their radii were marked with a convenient scale, the third and fourth terms of the proportion would be at once found by mere inspection. They can be made to any required ratio, and would be always ready for use.

logarithmic curve, that it be constructed with very great accuracy. The writer has procured his model in black rubber from Messrs. KEUFFEL & ESSER Co., of New York, and found it perfectly correct. Its longest radius from *C* is about 5½ ins., or 145 mm., and with scales of millimetres or 40 parts to an inch, may be used for obtaining any kind of ratios or proportions. The engineer will often find it useful to have such a curve at hand.

The Comparative Merits of Various Systems of Car Lighting.

VIII.

THE PINTSCH COMPRESSED GAS SYSTEM.—THE GAS MAKING PLANT. (*Continued.*)

Since our last issue we have received the following figures showing the cost of operation of the Erie gas works at Jersey City for two half-year periods, ending Jan. 1, 1888, and Jan. 1, 1889. A brief description of these works was given last week.

Six Months, Ending Jan. 1. 1888: Coal used, 383 tons, cost, $504.31; oil used, 48,162 galls. cost, $902.63; gas made, 2,697,400 cu. ft.; cost per 1,000 ft. for coal, 22 cts., for oil, 33 cts.—cu. ft. gas per gal. oil, 70.7. Average total cost of gas per 1,000 cu. ft., as follows: July, $1.75; August, $1.77; September, $1.50; October, 1.48; November, $1.33; December, $1.34.

Six Months, Ending Jan. 1, 1889: Coal used, 447 tons, cost, $690.76; oil used, 49,629 galls., cost, $1,903.-94; gas made, 3,430,000 cu. ft., cost per 1,000 ft., for coal, 20.1 cts.; for oil, 55.5 cts.; cu. ft. gas per gall. of oil, 69.1. Average total cost of gas per 1,000 cu. ft., as follows: July, $1.37; August, $1.28; September, $1.67; October, $1.44; November, $1.98; December, $1.65.

In the above figures the measurements of gas were made as it passed through the meter before compression. The additional cost of car filling is about 25 cts. per 1,000 ft.; while interest and depreciation, which are not included in the above, may be figured as 10% on $18,000, the total cost of the works. This would make an additional charge of $150 per month, or about 28 cts. per 1,000 for the average monthly output of gas in the 1888 period, and 33 cts. per thousand for the 1887 period. It will be seen from the above that the Erie makes an excellent showing, the yield of gas per gallon of oil being higher than in any other American works reported.

A piece of economy in the operation of Pintsch gas works which has recently been undertaken is the utilization of the waste heat from the retort furnaces for raising steam to run the gas-compressor. It has been the custom heretofore to have a boiler entirely separate from the gas making plant to furnish steam for the compressor, and it requires nearly as much coal to run this as is used to heat the gas retorts. In the Pintsch gas works recently built at Savannah, a steam boiler has been set directly above the retort furnaces. An extra furnace without retorts is provided for use when the waste heat from the retorts does not make sufficient steam. It has not been in use long enough to determine what economy is obtained.

The question of danger in operating the gas works making and compressing Pintsch gas is one which has been much discussed. In the paper by Mr. HUNTER before the Institution of Civil Engineers we find only the following reference to irregular operation of the apparatus:

> While the oil is undergoing the process of distillation, there are several means of ascertaining if this is proceeding continuously, and under the most advantageous conditions. Supposing a given quantity of oil per hour is flowing into the retort, and a suitable temperature is maintained, a glance at the meter will show what quantity of gas is passing and whether it is regular in volume. Should the latter be irregular, it indicates a stoppage, the location of which can be ascertained by reference to the pressure gages, whether in the tar-pits, condensers, washers or purifiers. At the same time the gas would "blow out" from the water safety-valve, alongside the main valve, and also at the siphon oil-pipe; while if anything goes wrong with the gasometer, the gage falls, and a blow out takes place.

Mr. AYRES, in his paper before noted, alludes also to the necessity of keeping watch of the gages and stopping operations in case any of the pipes become choked.

One of the members who took part in the discussion upon Mr. AYRES' paper was Mr. JOSEPH TOMLINSON, Jr., who was a member of the committee appointed by the Society of Arts to adjudicate upon the best system of train lighting. The other members of the committee were MYLES FENTON and Sir FREDERICK ABEL, and as a result of their investigation the gold medal of the society was awarded to JULIUS PINTSCH, of Berlin. Mr. TOMLINSON said that it was not a good plan to place the oil cistern on top of the retort bench. In case of any slight stoppage, the pressure would raise the oil seal and might set fire to the vessel of oil. He therefore placed the oil supply tank on the side of the wall, a considerable distance away, and led the oil to the retorts by a small pipe.

Concerning the above Mr. ROBERT M. DIXON, Engineer of the Safety Car Heating and Lighting Co., furnishes us the following information:

> In the proof which you send referring to the question of danger, you quote from Mr. HUNTER. Our practice here does not accord with what he says. We use differential water gages connected with every part of the work, which indicate at once any slight stoppage. Of course we use the safety valve of which he speaks, but never allow the works to become in such a condition as to bring it into use. It is, however, frequently tested by shutting down the main valve of the works, and compelling it to blow off. We make our siphon oil pipes to have such a seal that they cannot possibly blow out. If a gas works is properly run, and it is an easy thing to do, stop-ups never occur. I have spent a great many days in works, and have never been present when there was a stop-up, nor do I know of a case where we have had one that caused a blow-out of any kind. The filling up of the pipes is very gradual, and the differential gages indicate the location of any construction.
>
> We have not placed our oil tanks over the benches for several years past, but have placed them on the side wall of the building.

An accident occurred at the gas works of the Central Railroad of New Jersey in Jersey City last March, and exaggerated accounts were publjshed in the newspapers at the time. The oil supply tank was placed on the wall and a gage glass was attached to it, indicating the height of the oil. This gage-glass was broken and the escaping oil caught fire. General Superintendent OLHAUSEN informed us that the loss amounted to very little, and that the pipes were rearranged after the accident "in a way which will make it almost impossible for another accident of this kind to occur."

The accompanying illustration, which, by the way, may be of practical interest to many users of crude petroleum besides gas makers, shows the arrangement of the oil tank and connecting pipes which was adopted. The crude petroleum is stored in large tanks, usually located some distance from the works. The small tank from which the gas retorts are supplied is placed on brackets, bolted high up on the side of the wall. The tank is a closed cylindrical vessel, and the oil is forced up into it by a small pump, the large storage tanks being on a lower level than the supply tank. To guard against the possible danger of the pump being left running when the tank is full and so bursting it, a pipe runs from the top of the tank through the wall to the outside of the building and connects to an open ventilator, and also to a pipe leading back to the storage tank. It is therefore impossible to put the supply tank under pressure, and if oil is pumped in faster than it is used, all the surplus runs back to the storage tanks.

Attached to the small supply tank, in place of a glass gage, is a piece of 3-in. pipe, connected to the supply tank, and a float is placed within the pipe; an index rod is connected to the float and passes through the cap on top of the tube, indicating the depth of the oil on a graduated scale.

For a final precaution, a bell-crank lever is attached to a cock in the pipe leading from the supply tank to the retort, and two chains lead from it to different parts of the room. If from any cause fire does occur, the oil supply can be shut off without trouble. Besides this emergency cock, there is the micrometer cock, by which the flow of oil into the siphon leading to the retort is regulated; and there is also a cock, just outside the furnace, by which even the small amount of oil in the siphon can be shut off from entering the furnace.

We have been able to find no further evidence concerning the hazard from either fires or explosions in operating Pintsch gas works and no further records of their occurrence. Of course gas manufacture in these works as in other gas works has to be carried on with proper care. Both the gas and the substances from which it is made are inflammable; and if the former is mixed with the proper proportions of air, an explosive compound is formed. Either the lack of proper attention or wilful malice may cause trouble, therefore, as in any gas works, although the small amount of gas contained in the apparatus or in the holder would probably limit the effects of even the worst fire or explosion to the immediate vicinity of the works.

To test still further this matter of hazard in the gas manufacture, Mr. W. B. D. PENNIMAN, on behalf of this journal, sent inquiries to a number of railway officers who have had gr eatest experience with Pintsch gas manufacture in this country. One of the questions asked was: "Do you consider the manufacture of oil gas unusually hazardous to the men engaged in it?" The replies received were uniformly in the negative.

It is to be noted also, in considering the question of hazard, that the force required to operate a gas plant is very small, only from two to four men being on duty at a time. The hazard to life, therefore, even supposing the process to be a dangerous one, is not great.

Our attention has been called to an anonymous circular which was widely distributed sometime ago, containg newspaper extracts describing explosions of oil gas works in three cities. Concerning this the Safety Car Heating & Lighting Co. say:

> The gas works referred to in these circulars were not Pintsch works, or built in any way like them. The construction of Pintsch gas works is such as to make them in every way more safe than any other method of gas manufacture, and their operating history has been such as to obtain the confidence of railroad people. There are now 160 of these plants in daily operation.

We are also informed that the accidents referred to in this circular occurred at works using the Foster gas process, which was introduced on some railways a few years ago by the American Lighting Co., of New York City, a concern which we believe is no longer in existence.

STORING THE GAS AND DISTRIBUTING IT TO THE CARS.

As already stated, the gas passes from the compressor to the storage tanks. These are plain cylinders with welded seams about 4 ft. in diameter and 20 ft. long, set horizontally. The capacity of those at the Erie works at Jersey City is 265 cu. ft., so with 10 atmospheres pressure, each contains 2,650 cu. ft. of gas, or enough to fill about 20 cars. Of course only a small part of this number could be filled from the holder alone before the pressure would be reduced too low to give a proper amount of gas in the steel tanks on the car. In practice, however, when any considerable number of cars is being filled. the compressor is forcing gas into the holders as fast as it is drawn off. The Erie has five of these tanks at Jersey City to supply 265 cars and 6 ferry boats in service. The West Shore has two storage tanks to supply 150 cars in service. Tanks of this size weigh 6,000 lbs., and cost $760. The fittings cost $125 additional, making the total cost $885.

The amount of storage capacity for compressed gas required at any works depends upon the rapidity with which gas has to be delivered within a given time. If the gas were delivered from the works at a constant rate throughout the day, then two storeholders would be sufficient—one to pump into and one to discharge from alternately. This, however, is never the case, and sometimes large amounts of gas are required within a short time. The storage capacity is therefore arranged for the service, whatever that may be.

The gas as stored after compression does not deteriorate or deposit further hydrocarbon. Samples of gas examined after being stored for 10 months in cylinders at 150 lbs. pressure have shown the same candle power as when first compressed. The reason for this may be seen by remembering that the pressure to which the gas is subjected in the compressor is always a little higher than in the storage tanks, and this in turn is greater than the pressure in the distributing pipes or in the car reservoirs.

The preferable mode of distributing gas from the storage tanks to the cars is to lay a system of underground pipes along the car storage tracks, or wherever the cars can be most conveniently reached without special switching. In some cases the pipes are carried 10,000 ft. or more from the storage tanks.

The pipe usually used for even these very long lines is ¾ in. extra strong pipe with extra heavy recessed couplings. The joints between the pipes are

made with a paint of litharge and glycerine. When the pipe screws into any special fitting of brass the threads are tinned and the joint is soldered. In case of very long pipes of this small diameter when the flow through them is too slow, one or more store holders are placed at the distributing end to accumulate the gas and facilitate quick filling. At the Pintsch gas works in Chicago, where distributing pipes are in use over two miles in length, a 1¼-in. extra heavy pipe is used for the conducting pipe, and in order to thoroughly protect it and at the same time avoid any loss by leakage, it is laid inside a 2½-in. pipe which opens at the works into the low-pressure gasholder.

At the Central Railroad of New Jersey yards in Jersey City, ¾-in. piping is laid between alternate tracks to fill cars on either side. Filling valves are placed every 90 ft., and the 50-ft. hose used for filling the car tanks makes it possible to reach any car on the track on either side of the pipe line.

In case it is desired to fill cars at a considerable distance from the gas works, special tank cars are used. For example, at the Grand Central station, in New York City, cars are supplied with gas brought in special tank cars from the works at Mott Haven, 5 miles distant. The tanks which are placed on these cars are of the same size as the storage tanks at the works, 20 ft. × 4 ft. 2 in. They weigh about 6,000 lbs., and the two are placed side by side on the car. When charged to a pressure of 12 atmospheres they will contain over 7,000 cu. ft. of gas at atmospheric pressure. Three tanks could be as well carried on a car if the extra capacity were needed.

At the station where the gas is to be delivered there are generally several storage tanks and a compressor; by means of the latter all the gas in the tank car can be forced into the stationary holders, and the car can then return for another charge. The compressor also makes it possible to utilize nearly all the gas in the stationary holders, drawing from all but one and forcing the gas into this one as the pressure is lowered through the filling of cars from the distributing pipes. In case necessity should require, sufficient gas could be stored at the Grand Central Depot to supply 120 cars for three or four days.

The cost of a system of distributing pipes can be easily estimated by sketching the tracks to be covered, and measuring the length of pipe required. Laying the pipe costs very little, as a shallow trench only deep enough to protect the pipe from injury is all that is required. In passenger train sheds the distributing pipes are often run overhead.

It may be said that leaks in a system of gas pipes under 150 lbs. pressure would be very liable to start fires. As a matter of fact, however, leakages in the distribution pipes are rare. Should any occur, they can hardly do harm, since the gas generally escapes first underground and then in the open air or in a large open train shed. The strong odor of the gas also insures that a leak at any point will be detected as soon as it occurs. A small leak, even if it became lighted, would probably do no harm; and if the pipes were underground the gas would be so disseminated before reaching the surface that it could not be lighted.

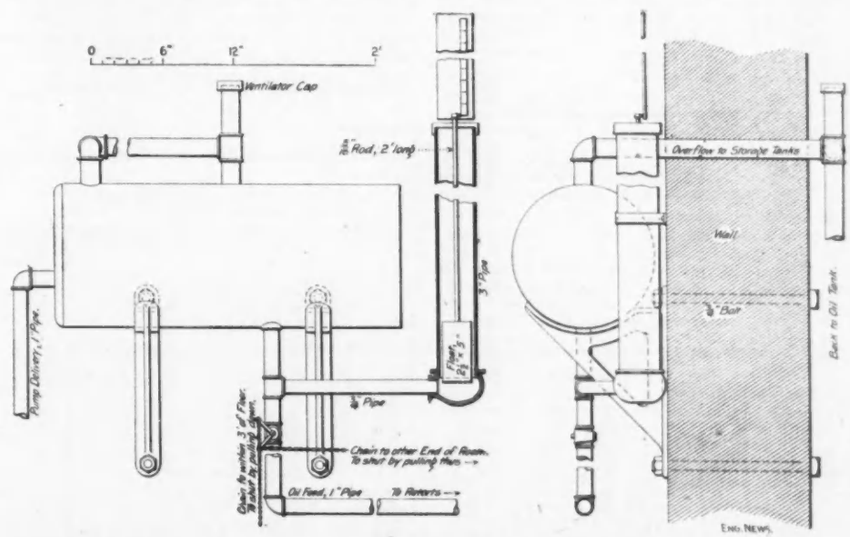
A more likely cause of accident, and one which has sometimes occurred, is the starting of a train through carelessness while the tanks are being filled and the hose from the distributing pipes is still connected to the car tank. Of course, in this case the hose is broken, and if the escaping gas reaches a flame it will be instantly ignited. We have been informed of one case of this sort in which the car was being filled in the evening. The man who was filling the tank had a lantern, which set fire to the issuing gas, and he was severely burned.

It is fair to say that the system in use in this case was not the Pintsch, but a compressed gas system using ordinary coal gas. The rules issued by the Pintsch Co. for the instruction of car-fillers call for the use of a safety lantern whenever artificial light is required in filling; but of course this precaution may or may not be enforced by the railway company.

Accidents like that above noted are, of course, always possible, however, and rules, simple enough so that they will be observed, should be established requiring the notification of conductor or engineer that the car-filling hose is to be connected, and later that the work is done and the hose is off. It is to be noted that fire occurring from this cause would always be on the outside of the car, and would occur only at the moment of starting. Danger to passengers from this cause, therefore, may be counted as nil. In proof of this we have the very extended experience with compressed gas of various sorts for car lighting extending over many years. If any injuries to passengers have ever occurred through the starting of cars with the hose connected, they have never been brought to our notice.

The hose used for filling is made of rubber, extra heavy, and is fitted with a cock at each end and a pressure gage at the end next the pipe line. The cocks in the hose are closed before it is disconnected from the car, and thus the escape of the gas contained in the hose while it is being moved from one car to another is prevented, and both the waste of gas and annoyance from its odor are prevented. With this hose it is seldom necessary to use artificial light when filling, as the gage can usually be read by the light from the cars. Even if a light is used, there is no need of carrying it near the cars, as the gage is on the end of the hose next the pipe line.

The length of time required to fill the tanks on a car is from three to five minutes, when two men are at work. When one man works alone a little longer time is required.



ARRANGEMENT OF SUPPLY TANK AND PIPES FOR FEEDING CRUDE PETROLEUM TO GAS RETORT.

Pintsch Gas-Works of Central Railroad of New Jersey, Jersey City.

TIN TO BE SENT TO ENGLAND is the promise made by H. SETON-KARR, a member of England's Parliament and a director in the Harney Peak Mining Co., of the Black Hills of Dakota. He says that 600,000 tons of fine ore averaging 2¼% are in sight and on the dumps; the mill is being erected and he shortly expects 500 tons of ore to be crushed daily. So says a Chicago dispatch, and adds that the mine owners expect to ship block and pure tin to England despite the Cornwall output.

Ten-Wheel Compound Locomotive; Mexican Central Railway.

(WITH INSET.)

A compound locomotive was brought out last year by Mr. F. W. JOHNSTONE, Superintendent of Motive Power and Machinery, Mexican Central Ry., which embodied a very novel arrangement of the cylinders. The compounding is done on the four cylinder system, but the high pressure cylinder on each side is placed inside the low pressure cylinder, the latter being in consequence an annular chamber with a piston in the form of a flat ring. A small annular chamber separates the two cylinders. Steam is admitted to and exhausted from the high pressure cylinder through ports or passages at the ends. The low-pressure cylinder has two piston rods, one above and one below the piston rod of the high pressure cylinder, the three rods being connected to the same crosshead. The fuel expenses in Mexico are very high, the cost of coal being about $11 per ton on this road, and this led to a careful consideration of the advantages of the compound system in securing economy in fuel consumption. The arrangement above briefly described was designed by Mr. JOHNSTONE, and in 1889 work was commenced on converting to this system a consolidation engine built by the Rogers Locomotive & Machine Works, of Paterson, N. J., in 1882. This engine had originally cylinders 20 × 24 ins.; driving wheels, 50 ins. diameter; a firebox inside the frames and 6 ft. long, and had a weight of 82,000 lbs. on the driving wheels. When compounded it had cylinders 14 × 24 ins. and 30¾ × 24 ins., the latter being equal (after deducting the area of the high pressure cylinder and surrounding sleeve) to a cylinder 24¼ × 24 ins. The cylinder ratio was 3 to 1. The length of the firebox was increased to 9 ft. 4 ins.

Careful tests were made of this engine, in November and December, 1890, and January, 1891, in comparison with a simple consolidation engine built by the Baldwin Locomotive Works, of Philadelphia, Pa.; having cylinders 20 × 24 ins., and driving wheels 48 ins. diameter. So satisfactory were the results that an order for six ten-wheel compound engines was given to the Rhode Island Locomotive Works, of Providence, R. I., and the plans of one of these engines are given on our inset sheet. It is also stated that a number of the railway company's engines are to be converted to this system. Owing to the small size of the boiler of the first compound, 52 ins., as compared with 60 ins. of that of the simple engine, there was less economy of water than would otherwise have been the case, and it was impossible to work the engine very hard on account of the wetness of the steam, while when working at all hard it was necessary to keep the water in the boiler as low as safety would allow in order to prevent the water being carried over into the cylinders. The heating surface, grate area, and water and steam space of the boiler were also considerably less on the compound than on the simple engine. The tests were made with different grades of fuel, and altogether 12 trips were made over a division 118 miles in length, with very little level track. The engines were not favored in any way, laying over at sidings for trains, and doing more or less switching at various points each trip, while the engine drivers were allowed to handle the engines without interference. The object of the test was to ascertain the consumption of fuel and water of the two engines in regular freight service. The "unit of work" used as a basis of calculation was 100 gross tons hauled 1 mile at a very low speed over a straight and level track. The results of the series of tests are given in the following table, in units of work per ton of coal and per ton of water,

the figures in each case being the averages of two trips.

TABLE OF COMPARATIVE EFFICIENCY OF COMPOUND AND SIMPLE LOCOMOTIVES, MEXICAN CENTRAL RAILWAY.

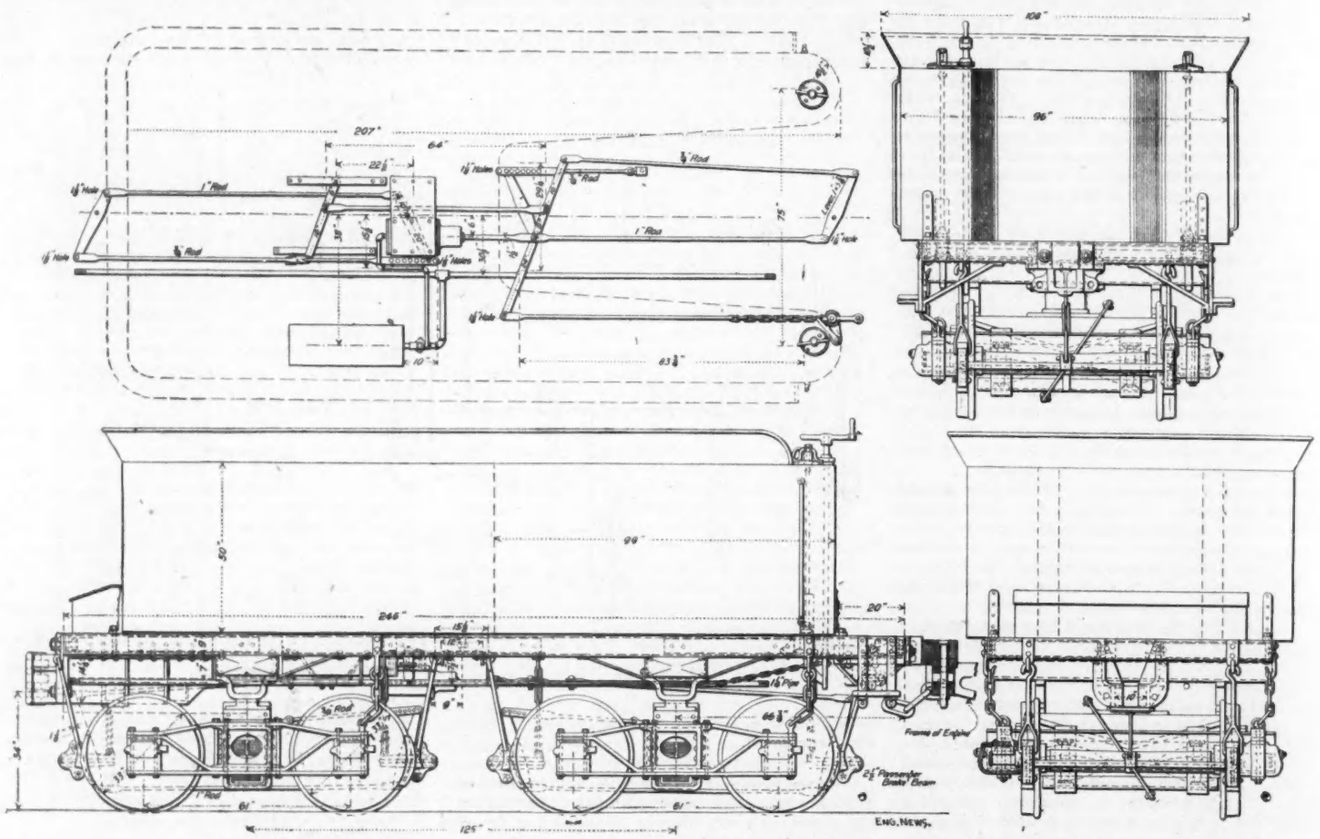
FUEL.	U. OF W. PER TON OF COAL.			U. OF W. PER TON OF WATER.		
	No. 66. Compound.	No. 107. Simple.	Difference in favor of compound.	No. 66. Compound.	No. 107. Simple.	Difference in favor of compound.
Bituminous coal from San Antonio, N. M...	242.35	192.80	49.55	43.70	37.15	6.55
	241.00	190.50	50.50	48.70	46.50	2.20
Bituminous coal from England.	266.65	214.80	51.85	46.25	37.95	8.30
	272.00	215.75	56.25	50.95	42.60	8.35
Briquettes of pressed coal. (Eng. pat. fuel)	303.00	241.05	61.95	43.95	35.50	8.45
	309.50	247.50	62.00	47.65	41.95	5.70

The following are the principal dimensions and particulars of the new ten-wheel engines which we illustrate this week:

Gage	4 ft. 8½ ins.
Cylinders: h. p	14 × 24 ins.
" l. p	29½ × 24 ins.
" ratio of l. p. to h. p	3 to 1
Distance c. to c	7 ft. 1 in.
Steam ports: h. p	1¾ × 14 ins.
" l. p	1⅞ × 14 ins.
Valve, h.p.: travel	5½ ins.
" outside lap	⅞ in.
" inside lap	none
Valve, l.p.: travel	4⅝ ins.
" outside lap	7/16-in.
" inside lap	none
Wheels: diam. of driving	56 ins.
" " truck	28 ins.
Journals: driving axles	7½ × 10 ins.
" truck axles	5 × 10 ins.
Pins of main rod	6 × 6 ins.
" side rod	6¼ × 4½ ins.
" " (front and back ends)	4 × 4 ins.
Wheel base: driving	11 ft. 0 ins.
" truck	6 ft. 3 ins.
" total	22 ft. 3 ins.
Boiler: diam. of smallest ring	60 ins.
Firebox	Belpaire type
" size at top of grates	41 ins. wide, 120 ins. long
Tubes: No., 278; diam., 2 ins.	
" length, 12 ft. 11¾ ins.; dist. c. to c., 2¾ ins.	
Boiler pressure	175 lbs.
Fuel	soft coal
Weight in working order: on driving wheels	105,000 lbs.
" " on truck	30,000 lbs.
" " total	135,000 lbs.
Tender	eight-wheel
Wheels: diam	33 ins.
Journals (collarless)	4 × 7½ ins.
Capacity of tank (galls. of 231 cu ins.)	3,000 galls.
" coal space	10,000 lbs.
Weight, loaded	60,000 lbs.

The arrangement of the cylinders and piston rods has already been described. The slide valve is a very important feature in this design, and is so constructed as to distribute steam to the high and low pressure cylinders, requiring but one valve stem, which is actuated by a link motion in the usual way. The valve is made in two sections, the outer portion distributing steam to the high-pressure cylinder and the inner section to the low-pressure cylinder. The inner section is carried by the outer, and has a travel of 4⅝ ins., while the travel of the outer section is 5¼ ins. The objects of this are to retard the point of cut-off to the low-pressure cylinder, and also to reduce the compression on the front of the high-pressure piston. The indicator cards show that these objects are effected satisfactorily. When the high-pressure admission is cut off at 9 ins., the low pressure continues open to the admission of steam for 17 ins.; but the compression on the high-pressure piston, which would begin at 9 ins. piston travel if both sections of the valve were made to move together with the same point of cut-off, does not take place until 17 ins. in the high-pressure and 19 ins. in the low-pressure cylinder. With a cut-off of 14 ins. in the high-pressure, there is a cut-off of 20 ins. in the low-pressure cylinder, compression beginning at 20 and 22 ins. respectively. A simple arrangement of starting valves enables the engine-driver to admit live steam to the low-pressure cylinder through a small piston valve in the top of the steam chest, which by an opening through the balance plate connects with the exhaust passage of the high-pressure valve, so that when the small piston valve is raised the live steam passes through the exhaust passage of the high-pressure slide valve and into the low-pressure cylinder. When this is done, the high-pressure pistons are put in equilibrium, but the two low pressure pistons act with a force of two high-pressure pistons of 24¼ ins. diameter, so that the engine has a much greater starting power than any simple locomotive of ordinary construction.

The pistons and valves are of cast iron, and the piston heads are babbitted to keep them central in the cylinders. The guides are of cast iron, crossheads of cast steel and piston rods of hammered steel. The U. S. metallic packing is used for piston rods and valve stems. The connecting and coupling rods are of I section, and the former have solid ends. A brake pipe is carried to the front end of the extension smokebox. The middle pair of drivers have blind tires. The leading coupled axle has the springs over the axle boxes, but the other driving springs are placed between the axles, giving an upward thrust on the top bar of the frame, and being connected by rocker arms resting on the top of the axle boxes; the rear ends of the rocker arms on the tailing axles are held down by double coiled springs. The grates have rocking bars, and there are two ash pans, the larger one behind and the smaller one in front of the trailing axles. An air ejector is employed to apply the sand to the rail. The boiler feed is supplied by a No. 9½ Sellers improved injector and a No. 9 Friedman injector. The cab is of sheet iron ⅜-in. thick, with angle iron frames. It is 8 ft. long, while the roof projects 5 ft. over the tender footplate. Both engine and tender are fitted with the New York Air Brake Co.'s brake.



TENDER FOR STANDARD TEN-WHEEL COMPOUND LOCOMOTIVE; MEXICAN CENTRAL RAILWAY.

The boiler is of steel ⅝-in. thick] and is 60 ins. diameter at the smallest ring. At the hole for the dome, which is 30 ins. diameter, the boiler plate is flanged and is strengthened by an inside ring ⅝-in. thick. The dome, firebox shell, smokebox and tube plates are ½-in. thick, the firebox sides and back plate 5/16-in., and the crown sheet ⅝-in. thick. The crown stays, brace rods and transverse stays are 1 in. diameter. The firebox is 10 ft. long, boiler, 12 ft. 11¾ ins. out to out of tube plates, and smokebox 5 ft. 0¾ in. long. The firebox is of the Belpaire type, which is now coming into very extensive use. It is 10 ft. long, 3 ft. 5 ins. wide inside at the grates, 4 ft. 9 ins. wide outside at the top, and 5 ft. deep. The firebox

shell is 5 ft. 8¾ ins. wide over all at the top and 20 ins. clear above the crown sheet. The details of the boiler are shown on the inset sheet.

The tender is of the ordinary American form, having a horseshoe tank and being carried on a pair of four-wheel trucks. Length over frame, 20 ft. 6 in. Width over top molding of tank, 9 ft. The tank is 17 ft. 3 ins. long over all, with legs 8 ft. 3 ins. long; width, 8 ft.; depth, 4 ft. 2 ins. The trucks have diamond frames, and channel iron transoms. Diameter of tender truck wheels, 33 ins. Truck wheel base, 5 ft. 1 in. Distance c. to c. of trucks, 10 ft. 5 ins. As already noted the New York air brake is used, and there is a brake shoe to each wheel. The construction of the tender and the arrangement of its brake rigging are shown in the accompanying cut.

AN INTERNATIONAL PRONOUNCING GEOGRAPHICAL DICTIONARY has been recommended by the Geographical Congress in its late session at Berne. A large majority of the Congress also declared that the English prime meridian ought to be universally adopted, and that England ought to accept the metric system. A special committee of the congress declared Capt. GLAZIER'S pretension that he had discovered the true source of the Mississippi to be unfounded. The honor of this discovery belonged to SCHOOLCRAFT, Lieut. ALLEN and JEAN NICOLLET.

A GEOLOGICAL SURVEY OF THE ADIRONDACKS has been commenced by U. S. Engineers H. M. WILSON and HENRY GANNETT. They expect to survey 500 sq. miles per annum, and complete the work in from 5 to 8 years.

THE MEXICAN COAL DEPOSITS which have been recently discovered are reported to be very rich. Operations are being carried on about 40 miles from Ortez, on the Sonora Ry., between Hermasillo and Guaymas. The concession, which covers 4,000,000 acres, is owned by a Mexican company. The coal has been found in borings 50 miles apart; the diamond drill has gone through three veins of 3 ft., 4 ft., 7½ ft., and has penetrated a fourth 22 ft., and is still working in coal. The coal is said to equal the best Lehigh Valley product and can be traced for miles on the surface. The importance of this discovery can be seen when it is known that one of the greatest drawbacks in mining in Mexico has been lack of a cheap fuel, and it is estimated that coal can be laid down in California for $5 per ton.

THE CALIFORNIA DESERT LAKE, say the engineers of the Southern Pacific Railway, covers a surface of about 156 square miles. "Two channels enter it—one known as the New River, the other a broken arroya. The latter was closed a number of years ago by sand, but the high floods in February last washed it out, and through it most of the water entered the desert. The first rush of water amounted to 16,000 cu. ft. per second, and commenced in the latter part of June. Now, it is only 3,000 cu. ft. Since the 15th of July this flow has been balanced by evaporation, and the water in the lake has not risen and is now receding. It will probably all be gone before next year's floods appear, but is likely to be formed every year until the channel is again closed by the sand. Hardo's Colorado, which it was said was taking water from the Gulf to the lake, is really flowing in the other direction, taking water to the Gulf from a lagoon midway between Salton Lake and the break in Colorado River."

THE PEARY ARCTIC EXPEDITION, says the Philadelphia *Press*, has reached McCormick Bay in latitude 77° 40′ N., and the *Kite* with its party of scientists has arrived at St. Johns, on its way down after leaving Lieut. PEARY and his small party at the point where he expects to commence his land journey north through Greenland. He sailed north from Upernavik on July 2; was caught and detained in the ice-pack in Melville Bay until July 24, and the *Kite* was nipped in the ice and only escaped destruction by extraordinary effort and the use of dynamite. While in this ice-pack Lieut. PEARY was unfortunate enough to have his leg broken, just above the ankle, by being entangled in the rudder-chains. He persisted in his purpose, however, and finally reached Cape York. Passing on north, Whale Sound was found to be frozen throughout and offered no landing place for the expedition; so they sailed on until McCormick's Bay was reached, as above stated. The shore south of Cape Cleveland was selected for the winter quarters, and PEARY'S provisions were landed and his house built, and 7 tons of coal were given him, all that could be spared, owing to the detention of the *Kite* in the ice. Mrs. PEARY has been a ministering angel to her husband, and she will stay with him through the winter. The party of Prof. HEILPRIN bade farewell to Lieut. PEARY on July 27, and starting back reached St. Johns, N. F., about Aug. 23.

THE 12-IN. RIFLED MORTARS, now being tested at Sandy Hook, are made of cast iron reinforced with steel hoops about the breech. They weigh 14½ tons and are 10 ft. 9 ins. long. The maximum powder charge is 80 lbs. and the shell weighs 630 lbs. with a bursting charge of 40 lbs. Fired at an angle of 60°, with a reduced charge, 10 consecutive shots at a range of 2½ miles all fell within a rectangle of 66 × 19 yds. The maximum range of 6 miles is to be obtained at an angle of 35°; to attain this range the shell arises 1¼ miles. One of these composite mortars has been fired 350 times. An all-steel type of mortar is now on the ground awaiting test. The 12-in. steel mortar weighs 13½ tons; is about 12 ft. long. The powder charge is to be 100 lbs., the shell will weigh 800 lbs. or even 1,000 lbs., and a muzzle velocity of 1,150 ft. per second is expected, with a muzzle energy of 7,334 foot tons. The cast iron steel hooped, composite mortar has a muzzle energy of 5,795 foot tons. It is expected that 30 of these modern mortars will be completed before August, 1892.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Lackawanna & Montrose.—O. A. Gilbert, of Montrose, Pa., the engineer in charge of work, writes as follows:

The grading has been completed and 10¼ miles of track laid on this railway from Montrose, Pa., to Montrose Station, on the Delaware, Lackawanna & Western R. R., 10.5 miles. The work is about medium, the route being partly through a farming country and partly through a woods. The first 5 miles will have a 2% grade, and there will be one 14° curve, two 13° curves and two 12° curves. There will be one trestle 700 ft. long and 35 ft. high. The contractors, Smith & Henwood, of Scranton, Pa., have about 200 hands at work, and expect to have the road in operation by Sept. 1. The Delaware, Lackawanna & Western R. R. will furnish the rolling stock and operate the road when completed. H. L. Beach is President.

Lake Champlain & Moriah.—S. B. McKee, of Mineville, N. Y., Chief Engineer, writes as follows:

The Fisher Hill Branch of this road is to run from Mineville, N. Y., north to near Elizabethtown, N. Y., a distance of 2 miles. About 50 men are now at work, and ⅓ of the grading is completed, and the road will be opened for traffic about Sept 15. The maximum grade is 4.1% and the maximum curve is 13° 30′. Burke Bros., of Scranton, Pa., are the contractors. The branch is being built for the iron ore shipment of Witherbee, Sherman & Co., and the Port Henry Iron Ore Co.

Findlay, Fort Wayne & Western.—A correspondent writes us that this road has now been completed to Evansville, O., on the Toledo, St. Louis & Kansas City R. R., 13.39 miles west of Ottawa, O. The grading is completed to the Indiana state line, 60 miles west of Findlay, O. The maximum grade is 15.8 ft. per mile, and the maximum curve is 10′. C. G. Patterson, of 10 Wall St., New York City, is the principal contractor. B. W. Fenton, of Findlay, O., is Chief Engineer.

Findlay Belt.—Nearly all of the grading has been completed on this 10-mile belt line railway around the city of Findlay, O., and tracklaying will begin in about two months. The line will cross 5 railways entering the city, and will reach a large number of industries. There are two bridges across the Blanchard River, about 150 ft. long each. Joseph Ramsey, Jr., of Cincinnati, O., is President.

Pittsburg & Moon Run.—It is stated that this railway from Groveton, Pa., to Remington, Pa., 6 miles, has been completed, and will be opened for traffic in November.

Wabash.—A dispatch from Detroit says:

James F. Joy, of the Wabash Ry., has arrived here from London, where he has been in conference at Winchester House with the English holders of Wabash bonds and stock. In an interview Mr. Joy said: "We held a meeting at Winchester House two weeks ago, the sole purpose of which was to discuss the matter of building a new line into Chicago from Montpelier, Ind., which latter point the Wabash direct line now reaches. The meeting decided to begin building the extension right away. This new through line will be 14 miles shorter between Detroit and Chicago than the other route. From Montpelier, on the Wabash, the new road runs straight west to the Indiana state line. There are 25 miles already graded from Montpelier west, and work is in progress still further west in a deep clay cut in Laporte County, Ind. A large number of Indiana towns will become contributors to Detroit. From our depot grounds in Chicago we have a track extending 20 miles out to the Indiana State line."

Dutchess County.—About 150 men are now at work on this railway and track is being laid from Hopewell Junction toward Poughkeepsie. Work will also begin at the Poughkeepsie end in a few days. A. B. Paine, of Poughkeepsie, N. Y., is Chief Engineer.

Philadelphia & Reading.—This company has a corps of engineers at work surveying a proposed cut-off from the eastern terminus of the Oreland Valley Branch, at Oreland, Pa., to a connection with the North Pennsylvania R. R., near Edge Hill, Pa. Two additional tracks will be laid on the North Pennsylvania R. R. between Edge Hill and Jenkintown. At the latter point they will branch off to the east to connect with the Bound Brook Branch, and furnish a short line for the transportation of Schuylkill Valley freight to the East.

Adirondack & St. Lawrence.—Work is being vigorously pushed by the 3,000 men now engaged. Lathrop & Ellsworth, who are doing the work in the vicinity of Saranac Lake, have about 8 miles of track laid and a considerable additional distance ready for the ties. North from Malone to the Canadian line the grading is well advanced. The bridge over the Trout River will be about 800 ft. long and will require 300,000 ft. of timber in its construction. From Valleyfield, P.Q., south the grading is being rapidly completed and tracklaying is in progress. It is expected to have the line from Valleyfield to Malone completed in about six weeks.

Columbus, Hocking Valley & Toledo.—It is stated that this company contemplates the construction of a branch into Findlay.

Wheeling & Lake Erie.—Surveys are in progress for a branch from Rush Run, on the Ohio River, to Smithfield, O., a distance of about 8 miles. The object of the road is to open up coal lands owned by the company, and it is stated that construction will begin at once.

Projects and Surveys.

Westerly & Jewett City.—At a recent meeting of the stockholders of this company the following Board of Directors was elected: Alex. B. Briggs, Thos. H. Peabody, Orlando R. Smith, George H. Babcock, Leverett A. Briggs, Ira B. Crandall, George H. Spicer, Frank H Campbell, R. Taylor Church, C. G. Stanton and Albert R. Champlin.

Sewickley & Jeannette.—Chartered in Pennsylvania to build a railway from the mouth of Big Sewickley Creek to Jeannette, Pa., with a capital stock of $150,000. President, B. L. Wood, Jr., Pittsburg, Pa.

Bangor & Aroostook.—The locating survey has now been completed between Houlton and Monticello, Me., and a very favorable line secured. The maximum curve is 6° and the grades are all below 1%.

Southbridge, Sturbridge & Brookfield.—This is the name of the company which proposes to build a railway from Southbridge to Brookfield, Mass.

Hunter's Run & Slate Belt.—A. E. Lehman, of 711 Walnut St., Philadelphia, Pa., writes us as follows:

This railway is projected to run from Pine Grove Furnace, Pa., over Pine Ridge to slate quarries, a distance of 5½ miles. The preliminary and topographical surveys have been completed and the line will be located soon. The route is through a wild mountain region affording very fine scenery. The maximum grade will be 190 ft. per mile and the maximum curve 20°. There will be a loop with 20° curves and grades 155 ft. per mile. The object of the road is to open up slate quarries, and its principal business will be in slate, iron ore and agricultural produce. The contract for construction has been let to L. L. Bush, of Bird-in-Hand, Pa. J. C. Fuller, of Pine Grove Furnace, Pa., is President.

SOUTHERN.—Existing Roads.

Western Maryland.—The grading on the line from Williamsport, Md., to Cherry Run, W. Va., is completed, with the exception of a small section in West Virginia. Ryan & McDonald, of Baltimore, Md., are the contractors.

Ohio Valley.—President P. G. Kelsey is reported as saying that the railway from Princeton to Hopkinsville Ky., will certainly be built. The surveys are in progress and a force of several hundred hands will soon be put at work.

Kentucky Midland.—A party of capitalists, consisting of William Anderson, of Chicago; B. R. Coleman, of Cincinnati; B. F. Johnston, of Paris, Tenn.; N. R. Olcott, of Paducah, Ky., and J. F. Prestoe, of Paris, Tenn., have begun an examination of the old route of the Kentucky Midland extension between Paris and Sharpsburg and Owingsville. There is reason to believe that work will be commenced on the extension soon, and that it will be rapidly pushed. The road will have to be completed to North Middletown, Bourbon County, by January in order to secure the amount voted by that county.

Georgia, Florida & Western.—About 300 men are now at work on this Florida railway, and grading has reached the Wasissa River, 20 miles from Tallahassee.

Fincastle & Cloverdale.—Nine miles of the grading between Fincastle and Cloverdale, Va., have been completed, and work is rapidly progressing on the remaining two miles. As soon as the grading is completed tracklaying will begin. There is some talk of building an extension from Fincastle to Jackson, Va., about 12 miles.

Roanoke & Southern.—The first 13-mile section of this road, from Roanoke, Va., south, will be finished by Sept. 1.

Projects and Surveys.

Lake Jessup, Indian River & Atlantic.—Chief Engineer J. O. Fries, of Orlando, Fla., has completed the survey of this railway from Lake Jessup to Coquina, Fla. about 45 miles.

Unaka & Nolachucky.—Chief Engineer, R. A. Bowie

has begun the survey of this railway from Erwin, Tenn., to a point on the Knoxville Southern R. R. near Knoxville, Tenn.

North Augusta.—Chartered in Georgia to build a railway through the property owned by the North Augusta Land Co., in Aikin, S. C. Among the incorporators are: Pat. Calhoun, of Atlanta, Ga., and Patrick Walsh, of Augusta, Ga.

St. Louis & Birmingham.—It is stated that surveys will soon begin for the line between Florence and Clifton, Tenn.

Ohio & Virginia.—Chartered in West Virginia to build a railway from Point Pleasant, W. Va, to Lynchburg, Va. Among the incorporators are: A. H. Mahone, L. E. McWhorter and Elbert E. Hoffman, all of Charleston, W. Va., where the principal offices are located.

Newnan & Talbotton.—There is talk of making a survey for a railway between Newnan and Talbotton, Ga. The line would be about 50 miles long.

Louisville, Cumberland Gap & Atlantic.—Surveys will soon begin for this railway from Johnson City to Cumberland Gap, Tenn., about 80 miles. Thos. E. Watson, Johnson City, Tenn., Engineer in Charge.

Tredgar Mineral.—The certificate of organization of this company has been filed with the Secretary of State of Alabama. At a meeting of the stockholders recently held the following directors were elected: Wm. H. Forney, E. F. Crook, John S. Lane, W. H. Edmunds, J. F. Crow, Chas. D. Martin, Joseph W. Burke and James F. Crook.

Cape Fear & Cincinnati.—President Geo. B. Morton sends the following information to the *Manufacturers' Record:*

I have been completing arrangements for commencing grading our road in South Carolina at three different points. Before this could be done it was necessary to have our mortgage of $9,000,000 recorded at every county-seat in South Carolina through which our road is to be built. This has been done, and now as soon as the contractors can get their men and equipments on the ground they will begin grading; one party at Gaffney City, S. C., another at Greenville, S. C., another between Wilmington, N. C., and Charleston, S. C. The line begins at Wilmington, N. C., and runs south to Georgetown and Charleston. It passes through a fine truck and fruit country much of which is heavily timbered. We have made some few detours to avoid swamps and save heavy trestle building, but these are insignificant, and we are as near to an air line as any road east of the great prairie States. Our route from Gaffney City, S. C., south is through a country rich in timber, in fine agricultural lands and in many other natural resources that can be developed when our road is in operation. The same statement applies with equal truth to our Greenville division.

NORTHWEST.—Existing Roads.

Duluth & Winnipeg.—Tracklaying has begun on the line between Cloquet and Duluth, Minn. It will be completed in about 30 days.

Dakota, Wyoming & Missouri River.—The work of construction has been begun on this proposed railway from Rapid City, S. Dak., west to the Wyoming coal fields. Wm. T. Coad, Rapid City, S. Dak., President.

Projects and Surveys.

Wisconsin Bee Line & West Superior.—It is stated that the contract for building the section of this railway between Waupaca and Iola, Wis., will be let soon. C. D. Smith, of Fond du Lac, Wis., is President.

SOUTHWEST.—Existing Roads.

St. Louis, Cape Girardeau & Fort Smith.—The preliminary survey for the extension of this road from Hunter, Mo., southwest, has been completed as far as Mammoth Springs, Mo., 45 miles southwest of Hunter. The survey will probably be continued toward Fort Smith, Ark.

Kansas City, St. Joseph & Council Bluffs.—The survey for the cut-off between Rushville, Mo., and Sugar Lake, opposite Atchison, Kan., has been completed. It is stated that construction will begin at once.

Fort Worth & Rio Grande.—The 32-mile extension of this railway from Comanche to Brownwood, Tex., was opened for traffic 79 days from the time of beginning work. The contractors were Hurley, Tierney & Lynch.

Missouri Pacific.—Work is reported begun on the extension of the Joplin & Western R. R. to Grand Falls, Kan.

Missouri, Kansas & Texas.—It is stated that this company has secured the property and franchises of the Denison & Wichita Valley Ry. Co., and will extend its line to Oklahoma.

Georgetown & Granger.—The grading on this Texas railway is nearly completed.

Velasco Terminal.—G. W. Angle, of Velasco, Tex., writes us that the contract has been let to E. S. Dreyer, of Chicago, for building this road. The road as surveyed is to run from Velasco, Tex., to Chenango and Oscola Junction, Tex., 60 miles. The route is through a very level country affording very easy grades and curves. There will be no bridges of importance. C. B. Farwell, of Chicago, is President.

Projects and Surveys.

Brookfield.—The people along the route are endeavoring to secure the construction of a railway from the Iowa State line north to Brookfield, Mo., 90 miles.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—Assistant Engineer E. H. McHenry, of Tacoma, Wash., is reported as speaking as follows in regard to the new work being done by this company:

We have begun no new work this year and it is not likely that we will, but we are laying a good deal of track. Last year considerable work was mapped out and started upon. That left us with but little to do in that direction this year. All the work which we started on this year had been begun last year, and although we have not begun any new work since 1890 we have built even more miles of road this year than during the preceding 12 months. I cannot give exact figures of the amount of new track laid and roads built without looking the matter up, but I am satisfied that it is larger than last year. The Lewiston extension is nearly completed and will be ready for operation shortly. The extension to South Bend will be finished this year also. We have done nothing with the Green River & Northern, and I don't think we will begin again this year. The double track between Puyallup and Tacoma is being built fast and will be done before the end of September. The line is being straightened out in the reservation at a point which has proven to be a dangerous curve. Bids have been called for by Mr. McHenry for the construction of the large iron draw span for the drawbridge which will cross the Chehalis River below Aberdeen on the line of the Tacoma, Olympia & Gray's Harbor road. The span will be about 290 ft. in length. There will also be three 150-ft. wooden spans built. Contractors Griggs & Heustis are now putting in the heavy piers of stone and masonry work. The total cost will approximate $100,000. Bids will be opened about the middle of next week.

Great Northern.—John N. Abbott is reported as speaking as follows in regard to the Pacific extension of this road:

We started in at Assinaboine late last fall and we have pushed the line across the main divide of the Rocky Mountains from Montana into Idaho. It is a rough, mountainous country, but with a large force of men and with all the latest appliances in the way of drills and blasting apparatus we continue to push through the rocks and mountains at an extraordinary rate. We expect by this fall to reach the shores of Lake Pend d'Oreille, about 50 miles from Spokane. The winter weather in the country between the main range of the Rocky Mountains and the Cascade Range is not severe and will not stop our track laying operations. We cross the Spokane River about 20 miles north of Spokane, and will run a branch to that city. We will cross the Columbia River at or near Waterville, in the Big Bend country, and then on through the Snohomish or Skaget pass, probably the latter, to Seattle. The Seattle & Eastern, recently acquired by the Great Northern, runs up to the Skaget Pass and when we reach that we touch the Pacific Ocean on the west and Lake Superior on the east. By July 1, 1892, we expect to have this grand transcontinental line in full operation, and with our eastern lake and rail connections we will be able to compete with any of them for through business.

Projects and Surveys.

Nelson & Fort Shepherd.—It is probable that the Canadian government will grant a charter to this company to build a railway from Nelson, B. C., south to the International boundary at Fort Shepherd.

The Dalles & Des Chutes.—Chartered in Oregon to build a railway from The Dalles, Ore., to a point at or above the east bank of the mouth of the Des Chutes River, in Sherman Co., Ore. Among the incorporators are D. B. Dufer, S. H. Johnston and R. H. Norton.

CITY TRANSIT.

Electric Railways.—New lines or extensions of existing systems are reported as probable in Alexandria, Va.; Knoxville, Tenn. address the New England Investment Co.; Galveston, Tex., address the South Texas Construction Co.; Augusta, Ga., address the North Side Electric R. R. Co.; Baltimore, Md., address A. H. Rutherford or D. H. Thomas; Sherman, Tex., address C. W. Batsell; Stockton, Cal., address the Stockton Electric Construction Co.; Caldwell, Idaho; Montreal, Que., address Alderman W. Kennedy; Brighton, Colo.; Dalton, Mass.; Logansport, Ind.; Conway, Mass.; Sherman, Tex., address the Sherman City Ry. Co.; Waterville, Mass., address W. T. Haines; Vincennes, Ind., address the Vincennes Electric Co., and the Central Thomson-Houston Electric Co.; St. Cloud, Minn.; Chester, Pa.; Canonsburg, Pa.

Brockton, Mass.—The Brockton Street Ry., about 13½ miles long, has passed under the control of the East Side R. R. Co., which operates 10 miles of electric lines. The deal is generally regarded as a preliminary step toward the extension of electric railways to the surrounding towns. The changes to be made this year are estimated to cost about $200,000.

Lowell, Mass.—G. B. Dammen, of New York, is said to be preparing plans for the electrical plant to be installed by the Lowell & Suburban Street Ry. Co.

Baltimore, Md.—A petition is being circulated among the residents along a part of the proposed cable line of the City Passenger Ry. to have a trolley line used instead of the cable system.

Roanoke, Va.—It is reported that the Roanoke street railway will be bought by a syndicate of New York capitalists, who will change the entire system to an electric railway. The company owns about 20 miles of track between Roanoke, Vinton and Salem, part operated by horses and part by dummies. Further details can be obtained from J. W. Christian.

Mt. Airy, N. C.—The Granite City Land & Improvement Co. contemplates building a 4-mile line to White Sulphur Springs to be operated by electricity or dummy engines.

Augusta, Ga.—J. F. Barre, of New York, has begun surveys for the line to be built by the North Augusta Land Co.

Mobile, Ala.—The Mobile Street Ry. Co. has decided to adopt electricity on its lines. The stockholders recently voted to increase the capital stock to $300,000, and issue $300,000 in bonds, to be secured by a mortgage on the company's property. The vote on this proposition was 5,840 for to 700 against.

Columbus, O.—It is reported that a proposal to build a line connecting New Albany and Gahanna with Columbus is very favorably received.

Alton, Ill.—It is reported that the companies operating horse and dummy cars in Middletown, Upper Alton and this city, will adopt electric motors.

Belleville, Ill.—At a recent citizens' meeting to organize a company to build a railway at this place with an extension to St. Louis, a representative of the St. Claire Turnpike Co., over whose route it is proposed to go, stated that the line would be built if the residents of Belleville will take up $50,000 of stock.

Jacksonville, Ill.—The local street railway company, which is preparing to change from horse to electric power, has been enjoined by a minority of the stockholders and the proposed changes have temporarily been given up.

Detroit, Mich.—President W. W. Cook, of the Detroit Street Ry. Co., is reported to have decided on introducing the Rae system on a part of his lines immediately.

Cable Railways.—New lines or extensions are reported as probable at Dardanelle, Ark., address W. J. Thompson; New York, N. Y., address J. S. Purdy, Garden Hotel.

Baltimore, Md.—Chief Engineer A. N. Connett reports that surveys for the new lines of the Baltimore City Passenger Ry. are nearly completed, and that the plans for the track work are well along. The conduits will be of concrete, without a steel lining, and have manholes every 30 ft.

Denver, Col.—The Denver City Cable Ry. Co. has contracted with Christie & Lowe for the construction of 3.06 miles of double track cable road, on which work will be commenced at once. The construction will be the same as that of the existing lines. The driving machinery for this extension was provided in 1889, when the company built its first cable lines. When the extension is completed it will have 14½ miles of double track cable road, all of which will be operated from one central power station, and there will be about 31 miles of rope driven from this one plant, the greatest length, probably in the world. Robert Gillham, M. Am. Soc. C. E., is Chief Engineer.

Dummy Railways.—New lines are reported as possible at Omaha, Neb., address J. W. Croft; Portland, Ore., address the Mt. Tabor Street Ry. Co.

Horse Railways.—New lines or extensions are reported as probable at Dadeville, Ark.; Bartow, Fla., address Frank Clark; South Pittsburg, Tenn., address the South Pittsburg Street Ry. Co.

New Companies.—People's Electric Street Ry. Co., Rochester, Pa.; capital stock, $50,000; incorporators, J. C. Whitta, of Beaver Falls; W. C. Simpson and H. M. McConnell, of New Brighton, and others. Barre Sliding Ry. Co., Chicago, Ill.; capital stock, $300,000; incorporators, C. A. A. Barre, of Paris, France; A. Kissam, of London, England; M. A. Meyer, P. Howarth, E. B. Felsenthal and others, of Chicago. Venice & East St. Louis R. R. Co., East St. Louis, Ill.; capital stock, $300,000; incorporators, C. N. Travans, J. B. Sikking, C. G. Robinson, and others. Kensington Electric Street Ry. Co., Pittsburg, Pa.; capital stock, $12,000; President, Henry Alles, Sr. Lawrence State Line R. R. Co., Pittsburg, Pa.; capital stock, $20,000; President, J. M. Bailey. Spring Hill Incline Plane Co., Allegheny City, Pa.; capital stock, $30,000; Treasurer, Chas. Cloffer. Effingham & Tentopolis Street Ry. Co., Effingham, Ill.; capital stock, $100,000; incorporators, W. S. Holmes, H. Overoeck, G. F. Taylor, J. A. Arnold. Hazleton & Suburban Street Ry. Co., Hazleton, Pa.; capital stock, $30,000; E. P. Kisner is interested. Chicago & Jefferson Urban Transit Co., Chicago, Ill.; capital stock, $1,000,000; President, E. D. Hosmer.

HIGHWAYS.

New York.—The Queens County Board of Supervisors, at Long Island City, have ordered that the Jericho turnpike be macadamized to a width of 18 ft. instead of 16 ft. Each village in the township will supervise the macadamizing within its boundaries and pay for the same. The macadamized road will extend from the Locust Valley station of the Long Island R. R. to Mineola, passing through the towns of Hempstead, North Hempstead, Flushing and Jamaica. It will be 6 miles long.

Michigan.—The Crapo Toll Road Co., with a capital stock of $10,000, has been organized at Big Rapids, W. E. Darrah, President; Chas. F. Stearns, Secretary and Treasurer. A survey has been made, and the road north from this city through the village of Paris to Crapo will be graded and graveled. It is said this will be the first toll road in the lower peninsula north of Grand Rapids.

WATER-WORKS.

NEW ENGLAND.

North Troy, Vt.—Bonds to the amount of $14,000 have been voted to pay for works said to be under construction.

Lancaster, N. H.—The Lancaster Water Co. have had surveys made for a gravity supply from Garland Brook.

A 6-in. main 4¼ miles long would bring the water to a reservoir on Holton Hill.

Attleboro, Mass.—A preliminary report on a new source of supply, from the Bungay Valley, has been made by the special committee. The estimated cost is as follows: Well, $8,000; pumping station and shed, $5,500; suction pipe and connections, $2,000; land and pipe lines, $16,000.

Hanover, Mass.—It is reported that the Hanover Water Co. will soon begin to build works.

Wallingford, Conn.—The contract for pipe laying has been awarded to Dennis Sullivan, M. Cormack & Eglee having withdrawn their bid.

MIDDLE.

Brooklyn, N. Y.—Bids for $300,000 of 4% water bonds due in 1910, were received Aug. 26 by Comptroller T. F. Jackson. A large part of the money raised will be used to lay a new main from the Ridgewood distributing reservoir. About 31,000 ft. of 48, 1,320 ft. of 36, 3,300 ft. of 30 and 3,000 ft. of 20-in. mains will be laid. Contracts for the pipe have been let.

Cazenovia, N. Y.—C. W. Knight has reported on increased water supply. The people have passed a resolution to the effect that no permanent additional supply shall be obtained except by gravity. A cheap temporary pumping station will be erected, if necessary.

Gilbertville, N. Y.—It is reported that a citizen has offered to build a dam in or near the village to form a water-works reservoir, provided the money necessary to lay mains be raised; estimated cost for latter, $3,000.

Jamestown, N. Y.—It is reported that the Board of Public Works is considering the matter of city water-works. The present works were built in '82 by a company.

Pine Plains, N. Y.—A canvass for water consumers is being made, and works may be built. Address S. J. Bowman.

Blossburg, Pa.—The Council has granted a franchise to L. A. Waters and L. Ammerman, Scranton. There will be 30 hydrants at an annual rental of $1,000. Construction, it is said, will be started at once.

Everett, Pa.—C. G. Masters informs us that the Everett Water Co. expects to begin construction soon. No contracts have been let. Supply, spring, pumped to reservoir. Population, 2,500.

Hyndman, Pa.—The Hyndman Water Co. was incorporated Aug. 19 with an authorized capital stock of $20,000, of which $100 was paid in. L. J. McGregor, Secretary, informs us that the supply will be from a mountain spring, by gravity. Estimated cost, $30,000. Engineer in charge of surveys, J. J. Whetstone, Buffalo. Population, 1,500.

Moscow, Pa.—A water company has been organized, with J. T. Richards as President. Proposed supply, lake at Daleville, two miles from Moscow.

Towson, Md.—Works are again projected, and there is talk of incorporating the town at the next meeting of the legislature.

SOUTHERN.

Front Royal, Va.—H. L. Cook, Baltimore, has been elected President, and C. A. Macatee, Secretary, of the Royal Water Co. It is said that construction will be started at once.

Grafton, W. Va.—It is reported that bids for building works are wanted. J. J. Gilligan is Town Clerk.

Huntsville, Ala.—Bids will be received by the Council until Sept. 20 for a 3,000,000-gall. pump and boiler to operate same. Pump will work against head of 175 ft.

Union City, Tenn.—It is reported that Guild & White, Chattanooga, have the contract to build works, and that 7 miles of pipe will be wanted.

NORTH CENTRAL.

Akron, O.—The Akron Water-Works Co. has increased its authorized capital stock from $250,000 to $490,000.

Eaton, O.—J. W. Hill, Cincinnati, has sent the following list of successful bidders at the water-works letting Aug. 18:

Pipe, Bradford Pipe & Foundry Co., Anniston, Ala.	$19,228
Stand-pipe, Variety Iron Works, Cleveland	4,220
Stand-pipe pier, Foster & Son, Lewisburg, O	5,578
Pumping station, Marks W. Nation, Eaton	6,294
Stop boxes, Bingham & Taylor, Buffalo, N. Y.	206
Fire hydrants, R. D. Wood & Co., Philadelphia, Pa.	1,724
Stop valves, Galvin Brass & Iron Works, Detroit, Mich.	701
Pumping machinery, Gordon Steam Pump Co., Hamilton	7,375
Pipe-laying, R. B. Carothers, Newport, Ky.	7,962
Connection of driven wells, 1,000 ft. at $1, R. B. Carothers	1,000
Total	54,268

Fremont, O.—Plans for an additional supply are under consideration.

Willoughby, O.—The Improvement Association has been investigating possible sources of supply and has petitioned the Council to take steps toward works.

Calumet, Mich.—It is reported that the contract for pipe-laying has been awarded to E. Henwood, Red Jacket, and that work has been started.

Jackson, Mich.—The Water Committee has recommended that the well near the flowing well be completed, and that a receiving well 30 ft. in diameter by 30 ft. deep be sunk near the present pumping station; that a 24-in. vitrified pipe be laid from the first named wells to the receiving well, and that the wells at the pumping station be connected with receiving well; that certain existing mains should be replaced with larger ones; a force main should be laid to connect with an elevated reservoir or stand-pipe. Bonds to the amount of $100,000 must be voted upon by the people.

Ludington, Mich.—Aug. 31 the town will vote on the purchase of the company's works.

Nashville, Mich.—The town clerk informs us that the people have voted for works, 195 to 75, and that $20,000 of bonds will be issued.

Northville, Mich.—Works are projected, to be built either by a company or the village. Estimated cost, $30,000.

South Haven, Mich.—The people will vote on issuing bonds for works.

Springfield, Ill.—It is stated that D. C. Cregier will report in favor of a 24-in. main from the river to the reservoir; estimated cost, $50,000.

Tomahawk, Wis.—W. W. Curtis, Engineer, St. Paul, Minn., has sent the following:

Bids for material and labor for works will be received by the Council until Sept. 2. There will be a 1,000,000-gall. pump, a boiler, wood tank or tower, frame pump-house, and about 250 tons of cast-iron pipe and specials, with necessary valves and hydrants. A. J. Olson is City Clerk.

NORTHWESTERN.

De Witt, Ia.—A well is being sunk and works are proposed.

Malvern, Ia.—Bonds to the amount of $7,000 have been voted for works.

Mount Pleasant.—The people have voted to buy the company's works for $32,500.

Winnebago, Minn.—The contract for works has been awarded to the Smedley Manufacturing Co., Dubuque. The works will cost about $9,250.

Madelia, Minn.—The contract for work has been awarded to Fairbanks, Morse & Co., St. Paul.

Blue Springs, Neb.—J. H. Casebeer, City Clerk, informs us that construction will probably be started by Oct. 1.

Schuyler, Neb.—F. L. Burrell, of Fremont, Designing Engineer, informs us that the contract for works has been awarded to the Michigan Pipe Co., Bay City, for $25,274, in 5% bonds.

Flandreau, S. Dak.—A. I. Whitman, Clerk, informs us that the village wishes to sell about $10,000 of bonds to enable it to build works, or to grant a water and light franchise. Proposed supply, river, pumping to tank or stand-pipe. Population, 750.

Crystal, N. Dak.—Fire protection works are talked of.

Dillon, Mont.—We are informed that the franchise granted J. H. Lawrence and others expires Sept. 1, unless construction is started, and that nothing had been done Aug. 18.

White Sulphur Springs, Mont.—We are informed that bids for a franchise are now being received. Address A. M. Henry.

SOUTHWESTERN.

Amarillo, Tex.—G. R. Wood informs us that a liberal franchise could be obtained here.

Austin, Tex.—Steps to buy the company's works are being taken by the Board of Public Works.

Baird, Tex.—The Baird Water & Power Co. has secured its charter and is receiving stock subscriptions

Corpus Christi, Tex.—H. Keller, Mayor, has sent the following:

A contract for building works has been given to Frank McMullen and Guido Jaeger, Rich Hill, Mo., for $82,000. The supply will be from artesian, open or gang wells, and there will be a stand-pipe, 6 miles of mains and 60 hydrants.

Denton, Tex.—It is reported that a flow of water has been secured and works will be built.

Gonzales, Tex.—City works are talked of. The present plant is owned by a company.

Huntsville, Tex.—There is talk of organizing a company to enlarge an ice factory and build water and electric lighting plants. Address W. S. Gibbs.

Longview, Tex.—We are informed that the town thinks of building works. W. H. Emerson has just completed a flowing well for an ice factory, and can give further information.

Stephenville, Tex.—Address W. C. Baldwin regarding proposed water and lighting plants.

Sulphur Springs, Tex.—O. M. Pati informs us that the city will receive proposals for franchise until Sept. 15. Proposed supply, wells or reservoirs, pumping to stand-pipe; estimated cost, $30,000 to $35,000. Population, 4,000. Address above.

Oklahoma, Ok. T.—The Oklahoma Water & Light Co., of Chicago, has been incorporated by H. S. Oakley and J. Gibson; capital stock, $300,000.

Pueblo, Col.—The mains will be extended to Lincoln Place, National Park and Capital Hill. Pipe has been ordered.——The Z. V. Trine Investment Co. proposes to build works to supply Overton, a new oil town 6 miles north of Pueblo.

PACIFIC.

Mount Vernon, Wash.—Fred Pickering has sent the following:

The Council has granted a franchise to J. N. Turner and others. Supply, river and spring, pumping to stand-pipe. Estimated cost, $15,000. The city has free water for public purposes for five years. Population, 1,800.

Oakesdale, Wash.—W. G. Gilstrop informs us that the town wishes to build works. Population, 1,000.

Spokane, Wash.—Capt. T. W. Symons, Consulting Engineer, has recommended that the proposed new supply be from the springs of the little Spokane. The springs are 594 ft. below the divide separating them from the city, and a pumping and repumping plants are favored. The daily capacity of the springs is said to be 24,000,000 galls., and the supply needed at present, 5,000,000 galls.

Berkeley, Cal.—W. G. Raymond, of Raymond & Bay, San Francisco, has been employed to make preliminary plans and estimates for a salt water street sprinkling, sewer flushing and fire protection works.

Oakland, Cal.—The Piedmont Springs Water Co. has been incorporated to operate in Alameda Co.; capital stock, $300,000; directors, W. J. Dingee, W. F. Boardman and others. Water will be taken from springs on the land of Mr. Dingee.

Ukiah, Cal.—City works are talked of. Small works are owned by T. H. Jamison. Address John McGlashan or F. Brunner.

Ogden, Utah.—The city talks of buying the new works.

ARTESIAN WELLS.

Lynchburg, Va—Address J. E. Edmunds regarding a proposed well.

Jacksonville, Fla.—Bids for a 6-in. well to be sunk in the city park are wanted.

Hammond, La.—It is reported that a well will be sunk.

Toledo, O.—The city talks of boring two wells.

Big Rapids, Mich.—A company is being organized to drill an 1,800-ft. mineral well and build a bath house.

Collinsville, Ill.—The council has appropriated $5,000 for a well. If successful, water-works may be built.

Litchfield, Ill.—An artesian well company is projected, and a 3,000-ft. well is talked of.

Niobrara, Neb.—S. Draper informs us that an artesian well will probably be started Sept. 1. If successful, water-works may be built.

Helena, Mont.—The subscribers to the artesian well fund ask bids until Sept. 10 for a 6-in. well, with a 5⅝-in. casing. Address Col. Broadwater, Montana National Bank.

Alvarado, Tex.—Money has been voted for a well. Address J. H. Russell, Mayor.

McKinley, Tex.—The Council has appropriated money for a well.

Seymour, Tex.—A well is talked of.

IRRIGATION.

Kansas.—A dispatch to the Kansas City *Times*, from Coolidge, states that an irrigation district was formed in Hamilton Co. recently under the irrigation law passed last winter, and that two more districts are talked of, adjacent to the first. Preliminary surveys have been made for a ditch taking water from the Arkansas River near Holly, Colo., and permission to divert water has been obtained from the Secretary of State of Colorado. The first district may supply water to the next two.

Beaumont, Cal.—There is talk of organizing a district.

Escondido, Cal.—According to the San Diego *San Diegan* the directors of the Escondido Irrigation District have voted to accept the offer of Moffett, Hodgkins & Clarke, Syracuse, N. Y., to supply 1,000 ins. of water at $300 per in., and an annual rental of $25 per in. in addition. The company proposes to deliver 200 ins. by July 5, 1892.

Huron, Cal.—The Huron Irrigation District is the proposed name of a district to include land lying between the Sunset district and the foot hills of the coast range. R. Jones is Secretary of the Committee having the matter in charge.

Lassen County, Cal.—The Honey Lake Improvement Co. has been formed, and a committee has been appointed to report upon a supply from wells.

Otay, Cal.—Robert Perry is working for an irrigation district to include about 45,000 acres near the Sweetwater River.

San Marcos, Cal.—There is talk of a new irrigation district.

Saticoy, Cal.—At a meeting held to discuss the organization of a district a resolution favoring the project was adopted, and J. M. Sharp, J. B. Kelsey and others were appointed as an investigating committee.

New Companies.—Island Irrigation Co., Burns, Ore.; $2,000; M. E. Dalton, Poso Canal & Irrigation Co., Visalia, Cal.; $100,000; E. O. Millers, J. G. Knox and others.

SEWERAGE AND MUNICIPAL.

Sewers.—*Maine.*—Gardiner. Plans and estimates are to be prepared by Mr. F. Danforth, of Gardiner.

Massachusetts.—Boston. The city engineer has been authorized to expend $55,000 on the extension of the sewerage system to Squantum.—Nantucket. A committee has been appointed to investigate the sewer question and engage an engineer to prepare plans. Mr. J. S. Barney, C. E. Snow and W. F. Codd are on the committee.

New York.—Cobleskill. An engineer has been engaged to prepare plans and estimates at an expense of $350.—Olean. Mr. J. A. Seymour, City Engineer of Bradford, has made a proposition to prepare plans and estimates for the proposed system.—Jamestown. The Board of

Public Works is considering the questions of paving and sewerage.

New Jersey.—East Orange. The Township Committee has declined to participate with Orange in the construction of a sewer to the Passaic River.—Belleville. The Township Committee will oppose the construction of the above sewer through its territory, on account of the consequent pollution of the river.—Orange. The bidders for the outlet sewer are James Smith & Son, Easton, Pa.; Joseph Moore, New York, N. Y.; Empire Construction Co., New York, N. Y.; James McParland, Philadelphia, Pa.; Sandford, Stillman & Co., Jersey City, N. J.

South Carolina.—Florence. A sewerage system is under consideration, and surveys are to be made. For particulars address the mayor.

Alabama.—Birmingham. Mr. J. W. Kendrick, City Engineer, has been directed to prepare plans for the sewerage of the south side.

Mississippi.—Vicksburg. An ordinance has been prepared authorizing the making of a contract with the Lewis Mercer Construction Co. for the construction of a system of sewerage.

Ohio.—Ashtabula. A sewer contract amounting to $22,000 has been granted to Mr. F. Groch.—Sidney. The State Board of Health has examined the location and plans of the system proposed by the city engineer, and recommended certain changes.

Indiana.—Muncie. A vitrified pipe sewer, 8 to 16 ins. diameter, with manholes, catch basins, flush tanks, etc., is to be built on Jefferson St.

Michigan.—Ypsilanti. The Council has accepted the report of the sewerage committee, recommending the construction of a main sewer on each side of the Huron River.—Ann Arbor. The sewerage question is being discussed.

Illinois.—Monmouth. An ordinance has been passed providing for the construction of a system of sewers.

North Dakota.—Grand Forks. The contract for vitrified pipe sewers has been awarded to W. P. Alsip and O. C. Jewett at $13,000.

Oregon.—Roseburg. A sewerage system is to be built.—Portland. The plans of Mr. Rudolph Hering, of New York, for sewerage for the East Side, have been adopted.

Washington.—North Yakima. About $42,000 will be spent on a sewerage system.

California.—Los Angeles. Work is in progress on the western intercepting sewer, which is a tunnel 6,500 ft. long, for a 20-in. pipe. Some of the shafts are 30 to 40 ft. deep. The contract price is $1.07 per ft. for excavation and pipe laying, and $50 per manhole.

Streets.—*Massachusetts.*—Chelsea. Vitrified brick paving is to be tried.—Malden. Brick sidewalks are being laid.

Rhode Island.—Providence. Vitrified brick paving is to be tried.

New York.—New York. A considerable amount of work is to be done in regulating, grading, paving and street improvement in the northern section of the city, under the Commissioner of Street Improvements.

Pennsylvania.—Pottsville. The Commissioners of Roads and Highways (Mr. N. P. Walker, chairman), are making an effort to start a systematic work of street paving.

Alabama.—Mobile. During July and August about 15,958 sq. yds. of sidewalk have been paved at an average cost of $1.50 per sq. yd.—Birmingham. The Street Committee has awarded contracts for street work amounting to $75,000.

Bonds.—Benton Harbor, Mich., $50,000 for public improvements. Orlando, Fla., $15,000 for paving, to be voted on Sept. 12. Dennison, Tex., $110,000 for sewers, streets, etc. Lynn, Mass., $200,000. Orange, N. J., $480,000 for sewers. Tampa, Fla., for street improvements. Columbus, Ga., for sewers. Norwood, O., $5,000 for sidewalks, proposals received Sept. 21, W. E. Wichgan, 137 Walnut St., Cincinnati, O.

Michigan.—Detroit. The Parkhurst Paving Co., o Minneapolis, Minn., is laying a patent cement curb on Woodward Ave., at a cost of about 75 cts. per lin. ft.

ELECTRICAL.

Electric Light.—New plants or extensions of existing systems are reported as probable in the following places: Ypsilanti, Mich., address Frank Tooker, of Bay City; Pensacola, Fla., address the Stratton Ice Works; Henderson, N. C., address the Henderson Light & Power Co.; Cordele, Ga.; Huntsville, Tex., address W. S. Gibbs or C. G. Barrett; Jonesboro, Ark.; West Bend, Wis.; Quakertown, Pa.; Manlius, N. Y.; Dallas, Tex., address the Mayor; Albion, Ia.; Carthage, Ill.; Muskegon, Mich.; Grand Haven, Mich.; Dillsburg, Pa.; Markdale, Ont.; Portland, Conn.; Cannelton, Ind.

Deposit, N. Y.—It is reported that $17,000 have been subscribed toward a plant.

Chattanooga, Tenn.—Guild & White will purchase a 750-light incandescent dynamo, 100 lamps of 50 c. p. and other supplies.

Kansas City, Mo.—The Merchants Electric Light Co states that subscriptions to the stock are being made in a satisfactory manner, and that a contract for the plant will be let soon.

New Companies.—Millersburg Electric Light Co., Mt. Vernon, O.; capital stock increased from $15,000 to $21,000 Urbana Electric Light & Power Co., Urbana, O., capital stock increased from $30,000 to $50,000. Georgia Electric Light Co., Atlanta, Ga.; capital stock, $600,000; incorporators, H. M. Atkinson, H. E. W. Palmer, J. H. Porter, and others. North Portland Light & Water Co, Portland, Ore.; capital stock, $10,000; incorporators, F. J. McKenna, G. H. Van Houten, C. N. Faulk. Edison Electric Light & Power Co., Fresno, Cal.; capital stock, $100,000; incorporators, J. M. Ryan, L. Gundelfinger, W. Fahey and others. Edison Electric Illuminating Co., Atlanta, Ga.; capital stock, $10,000; incorporators, J. F. Dickenson, W. H. Rhett W. H. Inman. Gray Electric Co., Chicago, Ill.; capital stock, $50,000; incorporators, E. Gray, F. K. W. Cushing, L. O. McPherson. Columbian Electric Light, Heat, Power & Mfg. Co., Jersey City, N. J.; capital stock, $1,000,000; incorporators, J. Hirshfield and W. Wright, of New York, A. P. Morison, of Montclair. Lake Charles Ice, Light & Water Works Co., Lake Charles, La.; capital stock, $100,000; incorporators, J. A. Landredth and others. Chicago Equipment, Chicago, Ill.; capital stock, $1,000,000; incorporators, R. H. Pugh, R. Wilbeforce, H. S. Munroe, Marshall Electric Light & Power Co., Marshall, Ill.; capital stock, $10 000; incorporators, G. L. Cragg, F. A. Wunders, E. M. Arnold. Cœur d'Alene City Illuminating Co., Cœur d'Alene City, Idaho; capital stock, $20,000; incorporators, M. R. Killinger, D. Thiery, C. D. Barry and others. Edison General Electric Co., Boise City, Idaho; capital stock, $12,000,000; incorporators are all residents of New York, represented in Idaho by John Cunningham, of Boise City. Oklahama Water & Light Co., Chicago, Ill.; capital stock, $300,000; incorporators, Chas. Wood, H. S. Oakley, J. Gibson.

CONTRACTING.

Street Work.—*North Tonawanda, N. Y.*—The contract for brick paving on Goundry St. has been awarded by Mr. T. W. Barrelly, City Engineer, to Wm. C. Long, at $2.58 per sq. yd. The Porter brick has been adopted. The pavement will be of vitrified brick upon a broken stone foundation, with medium stone curb and gutter.

Dolgeville, N. Y.—The contract for grading Main St. has been awarded to R. J. Guile at 27 cts. per yd.

Brooklyn, N. Y.—Proposals received by the Department of Public Works for grading and cobblestone paving on North Eleventh St. ranged from $1.95 to $6.57 per running ft.

Detroit, Mich.—The Board of Public Works has awarded two contracts for cedar block paving on plank foundation, at $1.73¼ and $1.83½ per sq. yd.

Jeffersonville, Ind.—The Street Committee has awarded the contract for improving Missouri Ave. to P. H. Sweeney, at $10.91 per sq.

Sewers.—*Detroit, Mich.*—Recent bids received by the Board of Public Works ranged from $3.07 to $3.74 per ft. for sewers, and from $30 to $40 for man holes.

Corry, Pa.—M. and J. McMahon bid $7.24 per ft. for 48-in. brick and $9.70 per ft. for iron pipe sewers. The contract has been awarded to W. J. Dunn, of Allegheny, Pa., at $63,139.

Covington, Ky.—Proposals for sewers at Fort Thomas were as follows: F. R. Vinnego, Hamilton, O., $2.82 per ft. for iron pipe, $12 for man holes; T. C. Brown, Newport, Ky., $1.14, $10; J. S. McLand, Newport, Ky., $1.70, $13.

Dredging.—*Buffalo, N. Y.*—The contract for dredging 26,000 cu. yds. in lower Black Rock harbor has been awarded by Mr. Hannan, State Superintendent of Public Works, to Hingston & Woods, of Buffalo, at 10¾ cts. per cu. yd.

Bridge and Masonry.—The County Commissioners of Westmoreland Co., at Greensburg, Pa., have awarded the contract for a new county bridge across Brush Creek to the Pittsburg Bridge Co., of Pittsburg, Pa., at $23.15 per lin. ft., and the masonry to W. J. Miller at $13.33 per cu. yd.

Levees.—Two contracts embracing 3 miles of levee work between Helena and Oldtown, Ark., in the Second Mississippi Levee District, have been awarded by Capt. S. W. Roessler, U. S. Engineer Office, Memphis, Tenn.: Hartnett & O'Brien, 135,000 cu. yds. at 18 cts. per cu. yd.; Oliver, Ferguson & Co., 100,000 cu. yds. at 18.96 cts. per cu. yd.

PROPOSALS OPEN.

Street Work.—*Ottawa, Ill.*—About 15,000 sq. yds. of double layer brick paving on sand. 5,000 ft. of sandstone curbing, 1,700 ft. of pipe sewer. James F. Farrell, City Clerk. Sept. 8.

Tarrytown, N. Y.—Grading and macadamizing on White Plains road. F. V. Millard, Town Clerk. Aug. 31.

Cincinnati, O.—Grading, curbing, gutters and boulder pavement on Baltimore Ave. Board of Administration. Sept. 18.

Birmingham, Ala.—About 25,800 sq. yds. of 1-in. asphalt paving, and 4,000 sq. yds. of brick paving. J. W. Kendrick, City Engineer. Sept. 3.

Sewer.—*Columbus, O.*—On Rich St.; 24, 30 and 36 ins. diameter. Board of Public Works. Sept 4.

Canal.—Excavating about 8,000 cu. yds. for canal between Long Lake and Old Town Bayou P. O. Thweatt, Cotton Belt Levee District No. 1, Helena, Phillips Co., Ark. Sept. 5.

Dredging.—Channel in front of the city of Oakland, Cal. G. H. Mendell, U. S. Engineer Office, San Francisco, Cal. Sept. 4.

Supplies.—Cement, sand, pebbles and broken stone; at Fort Washington, Md., and Fort Monroe, Va. Lieut.-Col. P. C. Hains, U. S. Engineer Office, Washington, D. C. Sept. 21.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 3 passenger engines to the Baltimore & Ohio. The Schenectady Locomotive Works, of Schenectady, N. Y., have an order for 5 two-cylinder compound engines for the Southern Pacific, one being a twelve-wheel freight engine weighing 144,000 lbs., with 115,000 on the driving wheels, and the other passenger engines weighing 129,500 lbs., with 98,000 lbs. on the driving wheels; the cylinders will be 20 and 29 ins. diameter. The Pittsburg Locomotive Works of Pittsburg, Pa., have an order for 10 engines for the Lake Erie & Western. The Illinois Central has placed orders for 20 locomotives, for use on the division south of Cairo, Ill. The Richmond Locomotive Works, of Richmond, Va., have an order for 4 passenger engines, with cylinders 18 × 24 ins. for the Seaboard Air Line.

Cars.—The Mount Vernon Car Mfg. Co., of Mount Vernon, Ill., is building 300 coal cars for the Cincinnati, Hamilton & Dayton. 300 box cars for the Illinois Central, and refrigerator cars for the Union Refrigerator Transit Co., of St. Louis, Mo. The Barney & Smith Mfg. Co., of Dayton, O., is building cars for the Kansas City & Inpendence. The Pullman Car Co. has an order for 21 passenger cars for the Baltimore & Ohio. The Haskell & Barker Car Co., of Michigan City, Ind., is building 250 box cars for the Wabash. The Illinois Central is having 1,000 box cars, 400 fruit cars and 100 flat cars built. The Ensign Car Co., of Huntington, W. Va., is building 200 box and furniture cars for the Southern Pacific.

Signal Plant.—The Johnson Railroad Signal Co., of Rahway, N. J., is putting in interlocking plants at Rockaway Junction, for the Long Island; at Auburn Junction, for the Chicago & Western Indiana, Wabash, and Belt Line, of Chicago; and at Atlantic, on the Old Colony. The company has just completed the equipment of Montauk Junction, Long Island City, for the Long Island.

The Pintsch gas plant at Savannah, Ga., is completed, and has a daily capacity of 20,000 cu. ft. per day. Pipes have been laid to the Savannah, Florida & Western, the Georgia Central and the Tybee stations, so that a train of cars can be supplied in a short time with gas sufficient for a journey of 24 to 72 hours.

Companies.—Extensible Car Step Co., of Kalamazoo, Mich.; H. B. Peck, Kalamazoo; $100,000. Virginia Asphalt Block & Concrete Pavement Co., of Roanoke, Va.; Vice-President, W. S. Wilkinson, Baltimore, Md.; $100,000. Single Rail & Saddle Truck Ry. Co., of Portland, Ore., J. B. Mahana, Z. T. Wright, A. P. Armstrong; $650,000. National Car Wheel Co., of Chicago, Ill.; C. L. Billings, A. E. Peters, George Patton; $100,000. Pennsylvania Artificial Stone Paving Co., of Lock Haven, Pa.; $30,000. George Car Coupler Co., of Birmingham, Ala.; to manufacture a coupler invented by M. H. George; secretary, G. R. Harsh.

Metal Market Prices —*Rails.*—New York: $30.75 to $31; old rails, $21.50 for iron and $17 for steel. Pittsburg: $30; old rails, $23.25 for iron and $17.50 for steel. Chicago: $31.50 to $32; old rails, $23 to $23.50 for iron and $14 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.7 to to 1.8 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.7 to 2.8 cts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.75 cts. with square and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.8 to 2.85 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $16.50. Chicago: $14 to $16.50

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 52½ and 42½ per cent. on black and galvanized butt-welded; 62½ and 50 per cent. on black and galvanized lap-welded. Casing 55 per cent.

Lead.—New York: 4.45 to 4.5 cts. Chicago: 4.25 to 4.3 cts. St. Louis: 4.2 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.35 cts. for shell, 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.1 to 2.2 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared plates, 2.25 to 2.35 cts. for iron; steel plates, 2.4 to 2.6 cts. for tank, 2.85 to 3 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.